NAVAL REACTOR PROGRAM AND POLARIS MISSILE SYSTEM

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JOINT COMMITTEE ON ATOMIC ENERGY
CONGRESS OF THE UNITED STATES

EIGHTY-SIXTH CONGRESS

SECOND SESSION

ON

REVIEW OF PROGRESS IN THE NAVAL REACTOR PROGRAM AND DEVELOPMENTS IN THE POLARIS MISSILE SUBMARINE SYSTEM

APRIL 9, 1960

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This hearing was held on April 9, 1960, 86th Congress, 2d session. Declassification, review, and printing were not completed until May 1961. The committee membership for the 87th Congress, 1st session, is as follows:

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FOREWORD

In 1960 prior to the first successful launching of a Polaris missile from a submerged nuclear submarine, the Joint Committee on Atomic Energy was privileged to spend 2 days at sea aboard the U.S.S. *George Washington* (SSB(N)598), the first U.S. nuclear-powered fleet ballistic missile submarine. During these 2 days, April 9 and 10, 1960, in company with AEC Commissioners John S. Graham and John F. Floberg, the Joint Committee was able to obtain firsthand knowledge as to the operation of the Polaris submarine missile weapon system and as to the competency of the naval officers and men assigned to it. It was evident to us that the nuclear-powered submarine provides a superb platform for the ballistic missile and that the marriage of submarine nuclear propulsion developed by the Atomic Energy Commission and the Polaris missile under development by the Navy provides the United States with a potent deterrent.

During the trip we received testimony from Vice Adm. Hyman G. Rickover and Vice Adm. (then Rear Adm.) W. F. Raborn on their respective contributions to this important program. The hearing was held in executive session over 400 feet below the surface of the Atlantic Ocean in approximately the same location where over 5 years before the Joint Committee had held a hearing on the then world's only nuclear-powered submarine, the U.S.S. *Nautilus*.

Much of the testimony received was classified and could not be made public at the time. Today some of the details still remain classified in the interest of national defense. However, through the cooperation of the U.S. Navy and the AEC, the transcript of the hearing was reviewed and classified information deleted prior to this public printing.

The Joint Committee was impressed with the achievements of Admiral Raborn in successfully developing the Polaris missile despite many difficult technical problems. Its success is due in no small measure to the extremely capable manner in which this fine naval officer administered the program. Admiral Raborn's testimony and answers to committee questions reflected his unusual competency and knowledge. The United States indeed is fortunate to have officers such as Admiral Raborn who so effectively can combine technical and administrative ability.

Of particular interest to us is the testimony received from Admiral Rickover relative to the special attention which he and his naval reactor laboratories give to the construction and safe operation of these nuclear propulsion plants. We share his conviction that continued safe and reliable operation depends heavily on this special attention. Reactor safety is of direct concern to this committee; we cannot afford to ignore the lessons of the recent SL–1 reactor incident at Idaho.

The rapidly increasing number of nuclear-powered ships brings added public responsibilities both to the Navy and the Atomic Energy Commission. The committee looks to the Atomic Energy Commission to continue as it has in the past to advise, assist, and cooperate with the Navy in the design, construction, test, operation, and maintenance of these ships. The committee also looks to the Navy to meet the Atomic Energy Commission's safety standards in all aspects of its nuclear propulsion program and to resist any pressures to force this new technology into an old system which may have sufficed for ordinary propulsion.

Nuclear propulsion is of extreme importance to the Polaris ballistic missile system. A naval reactor incident would have a profound effect on the entire program. Therefore, the Navy must work with the Atomic Energy Commission to insure that the safety record in this field is maintained.

The committee continues to be impressed with the careful attention Admiral Rickover devotes to the selection and training of personnel who operate naval nuclear propulsion plants and those who are technically involved in reviewing their design, construction, and operation. We strongly urge that there be no relaxation of Admiral Rickover's practice of insisting on personnel of exceptionally high mental capacity and dedication.

The setup we have today for handling naval nuclear propulsion works well; it produces results of which we are all proud. The Secretary of Defense and the Secretary of the Navy, in cooperation with the Chairman of the Atomic Energy Commission, should take whatever action is necessary to insure that the present organizational arrangement and methods for carrying out the naval nuclear propulsion program are strengthened and supported, so that the technical lead it has provided the United States is maintained.

CHET HOLIFIELD,
Chairman, Joint Committee on Atomic Energy.

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REVIEW OF PROGRESS IN THE NAVAL REACTOR PROGRAM AND DEVELOPMENTS IN THE POLARIS MISSILE SUBMARINE SYSTEM

SATURDAY, APRIL 9, 1960

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY.

The Joint Committee on Atomic Energy met in executive session pursuant to call at 8:52 p.m., at sea on board the U.S.S. *George Washington* (SSB(N)598), Hon. Clinton P. Anderson (chairman) presiding.

Present were: Senators Clinton P. Anderson (presiding), Henry M. Jackson, Bourke B. Hickenlooper, and Wallace F. Bennett; Representatives Chet Holifield, Melvin Price, Wayne N. Aspinall, James E. Van Zandt, Craig Hosmer, William H. Bates, and Jack Westland.

Also present: James T. Ramey, executive director; John T. Conway, assistant director; Richard T. Lunger, staff consultant; and Edward Bauser, technical adviser, Joint Committee on Atomic Energy.

Commissioners John F. Floberg and John S. Graham, U.S. Atomic Energy Commission; Vice Adm. Hyman G. Rickover, Assistant Director for Naval Reactors, Division of Reactor Development, Atomic Energy Commission, and Deputy Director, Bureau of Ships, Navy Department; and Rear Adm. W. F. Raborn, Director, Special Projects, Bureau of Naval Weapons, Navy Department.

Senator ANDERSON. This is an executive session hearing of the Joint Committee on Atomic Energy. We meet today aboard the U.S.S. *George Washington* more than 400 feet below the surface of the Atlantic Ocean. We are over 55 nautical miles from New London, Conn.

The U.S.S. *George Washington*, commissioned December 30, 1959, is the first of a number of Polaris firing nuclear-powered submarines which will give to the United States added strategic striking power. Earlier today the committee participated in the commissioning of the *Patrick Henry*, the second such missile-firing submarine. Others will follow.

Five years ago, on March 20, 1955, the Joint Committee held a hearing aboard the U.S.S. *Nautilus* in approximately the same location we are now. At that time, the *Nautilus* was the world's only nuclear-powered submarine. Today the U.S. Navy has 10 in commission. The United States is proud of this accomplishment. Each of these nuclear submarines and those that will follow, including nuclear-powered surface ships, represent a tribute to the dedication, the very capable dedication, of Admiral Rickover and his fine team of nuclear specialists.

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With the *George Washington* we have further evidence of fine team work. We see the results of the nuclear propulsion system under the direction of Admiral Rickover joined with the results of the Polaris missile system under the direction of Admiral Raborn. The combined leadership of both of these capable men has thus given the U.S. Navy another first.

Our hearing today is to receive testimony from Admiral Raborn and Admiral Rickover as to their work and to see for ourselves how well the Polaris missile-submarine program is progressing. We have toured the submarine and observed the crew at their stations during its operation. We observed the actual firing of dummy missiles while underway and the men at their battle stations.

I believe I speak for all the members of the committee when I say I am very much impressed by both the submarine itself and the men who man it. The captain, Comdr. James B. Osborn, is to be congratulated.

Admiral Raborn, I would like to call upon you at this time to review for the committee the Polaris program and then we will hear from Admiral Rickover.

TESTIMONY OF REAR ADM. W. F. RABORN, DIRECTOR, SPECIAL PROJECTS, BUREAU OF NAVAL WEAPONS, NAVY DEPARTMENT

Admiral RABORN. Thank you Mr. Chairman. With your permission I would like to show first a documentary film. I have a few remarks to make after that.

Senator ANDERSON. Surely.

(A 15-minute classified motion picture was presented.)

Admiral RABORN. Mr. Chairman, in the interest of brevity and considering the lateness of the hour. I will run just briefly through a few viewgraphs here and try to hit upon some items which have come to my attention that you are interested in.

Senator ANDERSON. You take your time.

Admiral RABORN. If we may have the viewgraph operator I will give you a short briefing. I won't give you a full briefing because of your knowledge of the program and also because the movie showed it better than I could describe it for you.

As you know, we are engaged in building a 1,500-mile system to be operational about March 1962. Due to the international situation we were asked to see what we could do ahead of time so we pulled a 1,200-mile system off this year and we expect to have the first submarine deployed this fall with 16 missiles in it. The *Patrick Henry*, the second submarine, will be deployed by the end of the year.

I would like to turn to communications right after this slide. A quick rundown on the status of the missile is on this viewgraph.

(A classified presentation on certain components of the missile followed.)

The guidance package has recently had some very successful shots. In fact we've had five fully successful guided flights. The exceptionally rugged guidance system itself has demonstrated that it is probably far more accurate than we had expected it to be.

The motors have come along quite well. The Navy pioneered on a breakthrough about 5 years ago and Polaris has the high specific im-

pulse which you get from a solid-propellant motor. By additions of light metals we were able to increase our specific impulse significantly. This immediately gave rise to a small two-stage solid-propellant motor. This is the first stage [indicating on chart] and the second stage [indicating on chart]. Of course we didn't know how to control it in flight because, as you know, in liquid-powered missiles the motors themselves swivel. But with solid-fuel missiles the motor being a part of the overall case does not permit this. As we couldn't do this, we used Jetavators. They dip into the gas streams and produce a ruddering effect there. It has proven quite successful. We certainly had our problems developing it. It jammed, and it stuck, and we had problems with the tremendous heat that is generated. We had problems with installations, problems with the motor case itself, keeping it light enough and keeping it strong enough. But we have arrived at a place where we are confident we are meeting our operational goals this fall.

The thrust termination is another thing we had to pioneer.

(Classified comments on thrust termination follow.)

Successful underwater launch from submarines is assured by an air-eject method using prototype—I mean using standard ejection equipment such as you have back in the missile compartment. Over 60 ejection tests, highly instrumented, have been made so we have very precise information as to where we are.

We have had nine successful advanced test vehicle flights. We have had five eject launches, five flights during which all equipment performed quite well. This system integrity, of course, has been assured by these flight tests.

I would like to turn for just a moment to communications. We had several questions earlier in the day. This is a picture, an artist's picture, of the Cutler, Maine, station. It will be the most powerful radio station in the world. Each one of these towers is bigger than the Eiffel Tower, so I am told. I have never seen the Eiffel Tower; I hope to get over there some day. This will be ready January 1 next year. This shows the coverage. The light area shows the assured coverage 365 days out of the year. This area varies outward from this but this is the minimum.

(Classified comments on ranges follow.)

This means that you can send messages to submerged submarines within these areas with assurance 365 days out of the year. I will tell you more about that in just a minute.

This is the coverage with the Jim Creek station, which I also mentioned. And so you see the coverage in the areas of interest.

(Classified chart.)

In addition to this very low frequency station, of course, we have a high frequency station for which you will have to use the regular antenna, a very inconspicuous thing. And we have a complete net with the many high frequency stations in this country and overseas and ships overseas which will be on regular circuit so that the submarine will never be out of communications from the United States.

We are building a 1,200- to 1,500-mile system. The light green shows the areas you can be in and still hit these targets. These are actual targets considered fit for this type of weapon. Now the Navy is very eager, as you know, to get into the 2,500-mile range which will

put you out in the dark green and still hit the same targets. We are confident—we know that we can do this by the mid-1960's—actually have them in the submarine. They will fit right into the submarines that are equipped for the 1,500-mile missile. The first submarines will be equipped with a 1,200-mile missile. With relatively small changes, they will be able to fire the 1,500-mile missile and the 2,500-mile missile.

Therefore, what we are looking for is this kind of progression up to the 2,500-mile system. The reason for this, of course, is to allow us to get into the broad Atlantic and broad Pacific. We should never become complacent although we are confident these submarines are going to be very safe and secure in NATO controlled waters. Nevertheless, we know the Soviets are going to put a prodigious effort to try to counter them. We are confident by moving into the broad Atlantic and broad Pacific that we will leapfrog any countermeasures they may possibly dream up.

Summarizing then the status of the submarines: We have four in the water, two are now in commission. The navigation equipments aboard the submarines have been integrated with a minimum of difficulty. Our navigational capability has been demonstrated in an actual submarine as well as in our navigational test ship to an accuracy which is twice as good as we expected or need. This is using the service equipment such as you have aboard this ship. The fire control has erected and fired missiles. All of our guided flights from Cape Canaveral and also from the missile firing test ship and from our ship motion simulator, have proven the fire control out to be a very beautiful piece of equipment. It is entirely satisfactory. That fire control takes the information from the navigational system and the information on the target and tells the missile, of course, where to go.

Now, we have had one fully integrated shot from the U.S.S. *Observation Island*, our weapons system test ship, which has all of this equipment aboard it except that we only have 2 launchers instead of 16, but we do have a complete system and we had a very successful shot on March 29 of the integration of shipboard equipment. The launching, of course, as I said before, has been well proven out and we are most confident of that.

I know all of you are acquainted with the recent acceleration which was directed, and I know some of you have seen perhaps the amount of weeks that we gained by this $52-million acceleration. Here it is [indicating on graph] and here are the savings in weeks beneath the submarines concerned [indicating] which we will get from this acceleration. We have been asked to make up all kinds of programs and slice this in many ways. I just show you a couple of typical ones and this information of course has been given to both the Congress upon their request and to the Department of Defense. This is a typical one. I show you this because we have about 15 different ways you could slice this. This incidentally was the recommendation of the present Secretary of Defense when he was Secretary of the Navy, and this was the recommendation of the present Secretary of the Navy to the previous Secretary of the Navy, Mr. Gates. But for many reasons, of course, I recognize people with much higher responsibility than I have, they decided not to go for this at this time but these show the figures and this shows the number of missiles by

the end of calendar years that you would have at sea with this kind of program.

I would like to show you the maximum. We were asked, "What was the maximum number of these that you would be interested in?" I mean that we could possibly do within the capabilities of the shipyards and so on. This then is the maximum. These are capabilities. I show them only as a matter of interest. We could lay down [number classified] submarines next year and [number classified] in fiscal year 1962 and these are the number of missiles at the end of those calendar years which you have to see—can see if you follow these out. (Classified chart.) This is indeed a heroic schedule, but this is a capability.

I would like to just show you this slide to introduce my next subject which is cost.

(Classified comments on future requirements follow.)

We are confident that these submarines, once supplied our country in numbers, can make a very significant contribution to our deterrent needs if it is desired to build them.

I would like to tell you about the cost. This is built upon a 1,500-mile system. It does not take into account the 2,500-mile system which would run about [classified]. To get the nine-boat program in its entirety would cost [classified]. This means all the research, development, reproduction base, the actual construction of the submarine, the ship filled with missiles, [classified] spare missiles, the spare parts, the out-loading facility at Charleston, instruction, and training of the crew. The [classified] dollars figures, I would like to point out are hard figures because we are actually under contract. These are not estimates. For about 2½ times this initial outlay you could get the rest of the 45-boat system. In other words you could add 36 boats to it, build additional outloading stations on the west coast and on this coast, 1 tender for every 9 boats. I will show you a breakdown of this.

(Classified comments on costs follow.)

Senator ANDERSON. Admiral, that's very, very fine. I do appreciate that. Admiral Rickover, we always depend on you to give us the—before you start, are there questions of Admiral Raborn?

(A series of questions and answers involving classified matters took place at this time.)

Senator ANDERSON. Very well. Admiral Rickover, you are ready now?

TESTIMONY OF VICE ADM. HYMAN G. RICKOVER, ASSISTANT DIRECTOR OF NAVAL REACTORS, DIVISION OF REACTOR DEVELOPMENT, ATOMIC ENERGY COMMISSION, AND DEPUTY DIRECTOR, BUREAU OF SHIPS, NAVY DEPARTMENT

Admiral RICKOVER. The Polaris missile is not my business, but Admiral Raborn neglected to tell you one important thing: That the Polaris missiles are prepared for firing by Navy crews and not by civilians. I believe it is the only missile system where, in the test phase at Cape Canaveral, naval personnel do this job. I think that's fine because it's building up an inhouse capability. This is what we have done for our nuclear plants from the very beginning.

Senator ANDERSON. Would you bring us up to date, starting with the *Nautilus*, the *Skipjack*, and telling us about this ship now, without the missile?

Admiral RICKOVER. The function of this ship is to fire missiles; the machinery plant exists to serve that purpose. Now, you might ask what is the purpose of the Polaris submarine? It is "to strike fear and terror in the hearts of the enemy." Long ago, in the days before missiles, there used to be a question in the officers' promotion examination in naval ordnance: "What is the purpose of the Navy's various projectiles?" One officer who had been up too late the night before answered: "To strike fear and terror in the hearts of the enemy," and he got by with that.

Congressman HOSMER. There is a remarkable nameplate up here on the bulkhead. It states the ship was authorized after the keel was laid.

Senator ANDERSON. Wasn't the ship originally planned as an attack submarine and later changed?

Admiral RICKOVER. The first three Polaris submarines were originally laid down as attack submarines. In order to expedite the Polaris program, they were shifted to the Polaris type.

Congressman PRICE. This ship was originally the attack submarine *Scorpion*, wasn't it?

Admiral RICKOVER. Yes, sir; this was originally the *Scorpion*, one of the three changed over. That is why it has been possible to complete the first Polaris submarine so fast.

Congressman HOSMER. Parts of this ship were the *Scorpion*?

Admiral RICKOVER. Yes, sir; all parts except the middle missile section.

Congressman PRICE. That explains the difference why the keel was laid before the Polaris ship was authorized?

Admiral RICKOVER. Yes, sir.

Senator ANDERSON. When we were in the *Skipjack* a year ago you brought us up to date on the safety of these nuclear submarines. Do you want to tell us a little bit about the safety now?

Admiral RICKOVER. Yes, sir; the safety of our nuclear submarines is a very important matter. To assure safety obtains both during the construction period and during the testing and operation periods we use the AEC laboratories and their personnel as necessary. The AEC scientists and engineers are directly involved from the very day the ship is authorized. We have AEC laboratory representatives right in the shipyards to help us. We started a new procedure with nuclear submarines where, instead of the shipbuilder operating the plants during the testing period, we require the ships force to do so. I believe Admiral Raborn is doing the same with the testing of the Polaris missiles.

The nuclear propulsion plant is very complicated; we felt it was far more important for the ships force, who will have to operate the plant at sea, to do the operating at the shipyard than it was for the shipyard employees to do so. This new procedure has now been adopted for all nuclear-powered ships.

In addition, we have brought to bear all the talents available in the AEC and its laboratories to help build, test, and operate these nuclear

ships. This procedure, however, runs afoul of the standard Navy system because it is new. There are some elements in the Navy who would like to throw this whole thing back into the system, which means the scientists and engineers from the AEC laboratories would be required to work directly through the Navy supervisor of shipbuilding. This would be very difficult to do and in all probability would not work satisfactorily. So I am faced with the continuous problem of assuring the safety of these ships and getting all the help I can from the Atomic Energy Commission, while at the same time the Navy keeps telling me to throw it all into the routine Navy system. I am afraid that with this sort of sniping we will just not be able to watch safety as closely or as directly as is necessary. Then we will start having trouble with safety. There is a very small margin between a reliable, safe reactor plant, and one which does not work properly and so is a menace.

In the system we now use, the scientists and engineers from Atomic Energy Commission laboratories join with the crews of the ships and with the shipyard people to supervise the testing and to assure that everything goes all right. If a problem or a question arises we get additional qualified people from our AEC laboratories to help us. There is no redtape, they come right away. We can also run tests on the AEC land prototypes or on the computers and critical facilities. It is an outstanding example of fast, close cooperation between two agencies of the Government. The Navy doesn't have facilities and people like this and they can't order the AEC people to do the work. It is and must be a cooperative effort. But it is very difficult, particularly in a military organization to get any new or unusual system adopted or even to keep an existing and successful one alive. The tendency of any bureaucracy is always to derogate and frustrate everything new or unorthodox and move it back into the old system. This is a big problem we constantly face.

Congressman WESTLAND. Admiral, would you care to discuss the security problems?

Admiral RICKOVER. Ever since Mr. Westland saw the plastic model of the Polaris submarine, which can be bought at any dime store, he questioned the propriety of releasing such information. I told him that I not only had nothing to do with the release but that I had recommended against it, because such information is extremely valuable to a foreign power. That information was handed out by the Navy. In fact a sheet of instructions accompanying each of these $2.98 models states that it is built in strict accordance with official Navy blueprints; that the Electric Boat Co. furnished complete and accurate data; that it is a complete and authentic accurately scaled model incorporating all the interior details of the actual submarine. If I were a Russian I would be most grateful to the United States for its generosity in supplying such information for $2.98.

Congressman WESTLAND. Is that right? Is the scale right?

Admiral RICKOVER. Yes; it is right. Of course, there are some deviations, but there is much that is correct.

Senator ANDERSON. Why do we keep it classified if a child can buy it for $2.98? Why can't we talk about it. We are not supposed to say much about the things we know about the submarines. We don't deal with how deep they go. We don't deal with how fast they go.

I don't think those are nearly as important as the actual design. If the actual design is released why do we worry about whether we go below 400 feet or go faster than 20 knots an hour?

Admiral RICKOVER. I agree with you, sir. This is the sort of thing our military services do in a mistaken attempt to build up public opinion for their particular projects. My own experience has been that much of this sort of publicity does no good. The people one must convince are the Budget Bureau and Congress, not the boys and girls who buy the models.

Congressman WESTLAND. You don't believe that that $2.98 job should be for sale, do you?

Admiral RICKOVER. I certainly do not, sir. Further, it is very difficult to get our manufacturers not to advertise and show pictures of various pieces of equipment they build for these ships. Mr. Westland and I had a discussion about this matter and he suggested I talk with Congressman Moss with the object of devising a method whereby we could prevent publicizing this sort of information, yet not have undue classification. This is a serious problem; we should have a more realistic rule on classification to take care of it.

Today we must do much of our work—particularly manufacturing some of our components—on an unclassified basis. This is because we use existing industrial facilities which also make valves, boilers, pumps and the like for other people. We couldn't possibly meet the requirements of the Armed Forces Security Manual for guards, fences, personnel clearances, safes, and so on for all of our equipment made in these factories without inordinately adding to the cost. The alternative under existing rules is to establish large duplicate classified facilities at Government expense just for our work. This would cost millions of dollars so I deliberately chose not to do that. I want to use all the flexibility of our existing industrial capability without needless Government expense.

But because we can't classify those factories we are told by some people that we can't control or limit in any way what is shown or published about our equipment. We are even told we cannot prevent it being licensed for manufacture by foreign companies, even though it is clearly identified as the same design as the equipment used in the U.S.S. *Skipjack* or *George Washington*, as the case may be. I don't believe that is the intent of our people or of Congress; I think we can work out a sensible compromise which will provide adequate security for these items and still permit us to do our work without additional large expenditures of Government funds.

Congressman PRICE. This information was released and made available to the toy manufacturer because it didn't reveal any reactor technology. Was just as important information revealed?

Admiral RICKOVER. Yes, sir; the dimensions of the ship were revealed, including the relative size of the reactor compartment and the machinery compartment. I was asked to release this information. I wouldn't do it. But a great deal of information has been released on the details of our machinery plants. I refused to make this public but it was released anyway.

Congressman PRICE. Do you tell a lot of information when you give the size of the reactor compartment?

Admiral RICKOVER. Yes, sir; you certainly do.

Senator ANDERSON. If one model has fallen into the hands of the Russians, or someone similar, why is it bad now to sell additional copies? They got all they want from that one.

Admiral RICKOVER. You are correct, sir; there is no point to withholding the sale of additional ones.

Senator ANDERSON. It is too bad we sold the first one.

Congressman WESTLAND. The only question is whether or not they know that it is as good as it is.

Admiral RICKOVER. Of course there are some errors in it. But a good ship designer can look at that model and quickly learn a great deal. He can spend 1 hour on that model and tell he has millions of dollars worth of free information. It also gives him an idea of how many men he could put into the ship and all sorts of other things. I just wouldn't do a thing like that. I see no reason why we should slave away and spend a lot of money and use up a lot of our talent and then just turn it over to a potential enemy. I'll ask you a question, sir: Can you conceive the Russians doing a thing like that? I certainly would like to have similar information on their submarines.

Congressman WESTLAND. It is inconceivable. The whole thing is inconceivable to me.

Admiral RICKOVER. That's the answer right there, sir.

Congressman PRICE. Getting back to the fact that even though it doesn't reveal any information on the reactor itself, it does give some information on reactor technology—aren't you more concerned that those toys are of the Polaris than they are of any other type submarine and that it gives away your whole arrangement on the Polaris?

Admiral RICKOVER. Yes; I personally am aghast that this was done, but our internal military controversy is so great that there is a tendency for each service wholeheartedly to fight the others in order to achieve its own objectives. You know that most of the leaks result from this interservice fight, I am sure.

Senator ANDERSON. I wonder if either or both, rather, of you would comment on this question of testing. How important is future testing in achieving an improved warhead for Polaris—

(Remainder of question classified.)

Admiral RABORN. I would be glad to talk on that. We have conducted innumerable studies as to the necessity for large yield warheads and invariably all studies that we have done, and all that I have seen in other services show the accuracy of delivery means more than increases in yield of the warhead. The accuracy of both the land base missile and what we have demonstrated in this system are just short of phenomenal. They are a lot better than we dared hope for. Although really, I think we could have foreseen this because we were shooting for this and could have gotten considerably better.

(A classified portion of statement follows.)

So while we certainly would never be in a position of saying we could not, would not, welcome reduced weight for equivalent yield or improved yield which can come about in increased testing, we are certainly not in the position at the moment of saying we are in dire need of such a thing.

Senator ANDERSON. You don't really need it.

Admiral RABORN. We are not in dire need.

Senator ANDERSON. (This portion of the question is classified.)

59086—61——3

I am only interested in finding out, because apparently something might come out of Geneva this summer. I was hoping for a little guidance as to how disturbed the Congress should be or how complacent it might be with what we now have. You are not hurting for it?

Admiral RABORN. I think I represent the Navy.

(Remainder of statement classified.)

Senator ANDERSON. Can you add anything else to the answer?

Admiral RICKOVER. May I talk some more about safety, sir?

Congressman PRICE. I would like to ask a question. It is sort of in that line. With the attitude of the Navy in regard to turning safety matters over to the Regular Military Establishment, it would indicate to me that perhaps they are considering nuclear-powered submarines and the Polaris-type submarines as conventional a little too early.

Admiral RICKOVER. That is correct, sir.

Congressman PRICE. Is there any indication that they are doing this in any other way which might adversely affect you?

Admiral RICKOVER. Nuclear power has brought many novel problems with it. The people in the Navy rotate very quickly. Nuclear power is a hard thing to understand, so they try to force it right back into the old system which they do understand. I'll tell you how this works, historically. When we started designing and building the *Nautilus* we held frequent meetings with the Reactor Safeguards Committee. After listening to our presentation the Safeguards Committee permitted the reactor to go critical. When we were ready to go to power the committee again reviewed the situation with us. We went up to the power alongside the dock and then, after another review, the committee said "We will let you go to sea and operate."

Then the question came up about going into ports other than New London. They reviewed that problem carefully and agreed that, although there was a certain risk inevitably involved, operation into populous ports should be considered acceptable when and if it was necessary for carrying out the Navy's mission or for other national purposes.

I would like to put into the record some of the correspondence among the Navy, the AEC, the Joint Committee, and the Safeguards Committee. These letters state the policy which has evolved but which is not always fully appreciated by the working level people concerned.

Senator ANDERSON. We would be glad to have that for the record.

(The material referred to follows:)

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
March 30, 1960.

The honorable the SECRETARY OF THE NAVY.

DEAR MR. SECRETARY: As you know, the Committee is studying the relationship and responsibilities of the AEC and the DOD for the operation of military reactors, with particular regard to the matter of public safety.

We would appreciate having Admiral Rickover testify aboard the USS *George Washington* on how he insures that the AEC is fulfilling its obligations in the building, testing and operation of these nuclear reactor plants, so that the public safety is adequately protected.

Recently, the Committee received, by Commission letter of February 15, 1960, copies of three manuals which Admiral Rickover's group prepared for use in connection with the operation of naval nuclear powered ships. We are pleased to see that these manuals reflect a deep sense of responsibility toward the

public welfare in the operation of the nuclear Navy and have been reviewed with other organizations having competence and experience in this field. The Committee is always gratified to learn of the work of the naval reactors program, especially where radiation and reactor safety are involved.

We have been impressed by the record of safe operations made by nuclear powered ships; the AEC and the Navy both deserve a great deal of credit for this. Our personal observation aboard these ships leads us to believe that in a large measure this is due to excellence of personnel and high state of training. There is a danger, however, that the safety record to date will be used as evidence that the time has come to consider relaxation of the close personal supervision of selection and training of personnel, the construction and testing of the propulsion plants, and the strict day-by-day control of the ships' operations. In the judgment of the Committee, the procedures currently in use, which have proved to be so effective, must be maintained and in fact could well be used as a model for the exploitation of other new and important military developments. The AEC should resist any attempt to turn these vital functions back to routine organizations.

The Committee is aware that the AEC, in fulfilling its responsibility for reactor safety, has contributed significantly to the safe operation of nuclear powered naval ships through its assistance in the prototype training program and its direct participation throughout the construction, testing and trials of these ships. The Committee considers that the rapid increase in the number of nuclear powered ships which the Navy is putting into operation makes it more essential than ever to maintain the existing arrangements whereby the development, construction and testing of naval nuclear propulsion plants are under a single technical direction from the inception of the development work to the delivery of the ship. This keeps the AEC and its naval reactors laboratories directly involved in the construction and testing of these plants. We know of no better way to insure that the potential advantages of nuclear power are rapidly exploited while the unprecedented hazards inherent in large quantities of radioactivity are kept under control.

The committee appreciates receiving these manuals, for it is clear that their importance is not limited to the naval program, and that the standards and procedures established in these manuals will undoubtedly find other applications in the expanding nuclear power field. We consider it essential that the AEC continue to work closely with the Navy in these matters, bringing in the U.S. Public Health Service, the Federal Radiation Council, the Advisory Committee on Reactor Safeguards, and other responsible and knowledgeable agencies as appropriate. The establishment of standards and policies in this new field are too important to be undertaken unilaterally by any one agency; having one responsible group operating within two government agencies has been shown to be an effective way of handling this situation efficiently.

Sincerely yours,

(Signed) Clinton P. Anderson,
Chairman,

(Signed) Chet Holifield,
Chairman,
Special Subcommittee on Radiation.

cc: Chairman, AEC.

DEPARTMENT OF DEFENSE,
MILITARY LIAISON COMMITTEE,
Washington, D.C., February 8, 1960.

Hon. JOHN A. MCCONE,
Chairman, U.S. Atomic Energy Commission.

DEAR MR. MCCONE: Forwarded herewith for your information and appropriate action is a letter from the Chief of Naval Operations, dated 4 February 1960, and three recent Navy technical manuals. These manuals were developed to insure that accurate information concerning reactor hazards and radioactivity is available to personnel working with naval nuclear-powered ships.

The procedures and criteria contained in these manuals have been developed through close cooperation between the Navy and the Atomic Energy Commission and other responsible agencies. I believe that the fine operating record of naval nuclear-powered ships can be attributed to a great extent to this kind of

cooperation between the Navy and the Atomic Energy Commission in matters involving reactor safety and radioactivity. I heartily endorse the continuation of this close cooperation.

Sincerely yours,

(Signed) WILLIAM W. DICK, Jr.,
Major General, U.S.A.,
Acting Chairman.

1 Enclosure: Ltr to Chmn, AEC, thru Chmn, MLC, from CNO, dtd 4 Feb 60 with—

3 Enclosures:

1. NAVSHIPS 389–0153 "Radiological Controls for Naval Nuclear Propulsion Plants" dated December 1959.
2. NAVSHIPS 389–0152 "Water Chemistry Control for Naval Nuclear Propulsion Plants" dated November 1959.
3. NAVSHIPS 389–0197 "Nuclear Propulsion Plant Safety Manual" dated January 1960.

DEPARTMENT OF THE NAVY,
OFFICE OF THE CHIEF OF NAVAL OPERATIONS,
Washington, D.C., February 5, 1960.

Mr. JOHN A. MCCONE,
Chairman, U.S. Atomic Energy Commission.
(Through: The Chairman, Military Liaison Committee to the Atomic Energy Commission).

DEAR MR. MCCONE: In my letter of 21 January 1958, I advised you that the Navy was preparing a number of technical manuals to insure the availability to naval personnel of accurate information concerning reactor hazards. These manuals are now complete and are included for your information as enclosures (1) through (3) of this letter.

Enclosure (1) contains procedures for control of radiation and radioactivity for naval nuclear propulsion plants. These procedures are based on recommendations of the National Committee on Radiation Protection and on criteria set forth in the U.S. Atomic Energy Commission Manual and the Code of Federal Regulations, Title 10, Part 20. These procedures have been accepted by the U.S. Public Health Service. They have also been reviewed and accepted by the AEC's Office of Health and Safety, Division of Licensing and Regulation, and Division of Reactor Development. These manuals have been discussed with the Secretary of the Federal Radiation Council, and copies are being sent to the Council for their information and use.

Enclosure (2) is the Navy's technical manual discussing the water chemistry aspects of naval nuclear propulsion plants. This manual contains the detailed radiochemical procedures used aboard nuclear-powered ships for the measurement and control of coolant chemistry and radioactivity. The procedures have been thoroughly tested to insure that the coolant waste disposal criteria set forth in enclosure (1) are met by all naval nuclear-powered ships.

Enclosure (3) discusses the reactor safety aspects of naval nuclear propulsion plants. This manual provides shipboard personnel with a compilation of information on reactor safety and general requirements for safe operation of naval reactor plant systems and equipment. The detailed requirements and limitations for each nuclear-powered ship are contained in the Power Plant Manual and the Component Instruction Books issued to each ship.

Enclosures (1) through (3) have been issued to all naval nuclear powered ships, to shipyards working with nuclear ships, and to the naval reactor prototype sites and nuclear power schools.

The Navy is currently working with your people and those of other appropriate agencies to develop further procedures covering other safety aspects of naval nuclear propulsion. Plans currently in preparation include: procedures for disposal of packaged radioactive wastes into the oceans; emergency plans for coping with any casualty involving radioactivity; and procedures for handling and keeping track of radioactive materials from repair and maintenance of naval nuclear-powered ships. The Navy plans to continue working closely with the Atomic Energy Commission in these matters and to develop procedures which are equivalent to those prescribed by the AEC for its own activities and for AEC licensees.

By previous correspondence I have described policies and procedures developed by the Navy for operation of nuclear-powered ships; for repair and maintenance of naval nuclear propulsion plants; and for selection and training of personnel for the nuclear program. I wish to reaffirm that the Navy intends to permit no relaxation of its standards in these areas.

The Navy recognizes that no rules or procedures can diminish the need for careful selection and training of personnel to insure that radioactivity is handled in a responsible manner. The Navy plans to maintain a high standard of selection and training to insure that only people with the necessary mental capacity and competence are entrusted with this responsibility.

Sincerely yours,

ARLEIGH BURKE,
Chief of Naval Operations.

Enclosures:

1. NAVSHIPS 389–0153 "Radiological Controls for Naval Nuclear Propulsion Plants" dated December 1959.
2. NAVSHIPS 389–0152 "Water Chemistry Control for Naval Nuclear Propulsion Plants" dated November 1959.
3. NAVSHIPS 389–0197 "Nuclear Propulsion Plant Safety Manual" dated January 1960.

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., April 1, 1960.

Adm. ARLEIGH A. BURKE, USN,
Chief of Naval Operations,
Department of the Navy.

DEAR ADMIRAL BURKE: This is in reply to your letter of February 5, 1960, which forwarded for the information of the Commission the following three Navy technical manuals concerning the operation of naval nuclear-powered ships:

(1) NAVSHIPS 389–0153 "Radiological Controls for Naval Nuclear Propulsion Plants" dated December 1959.

(2) NAVSHIPS 389–0152 "Water Chemistry Control for Naval Nuclear Propulsion Plants" dated November 1959.

(3) NAVSHIPS 389–0197 "Nuclear Propulsion Plant Safety Manual" dated January 1960.

The Commission notes that the radiological control procedures outlined in (1) and (2) above are based on criteria set forth in the Federal Regulations and recommendations of other responsible scientific groups. We believe the instructions in the manual represent reasonable and acceptable implementation of the basic criteria in their application to naval reactor plants. The Commission concurs with the Navy in the importance of having complete and well-considered radiation controls and commends the Navy policy of developing these controls in cooperation with the U.S. Public Health Service and the Atomic Energy Commission who have experience and obligations in this field.

The Commission also notes that the Nuclear Propulsion Plant Safety Manual (3) above, discusses principles in the design and operation of reactors which are of vital importance to reactor safety. We believe this will be highly useful as a reference document to the reactor plant operators and supervisors.

The Commission has been pleased to assist and advise the Navy in matters involving radiation, waste disposal, and reactor safety. These manuals represent one tangible result of the joint effort of the Navy and the Commission in this area. As you note in your letter, however, no manuals can diminish the need for personal attention by competent people. Therefore, the Commission intends to continue to have its representatives participate directly in the construction and test program of these nuclear plants, to make available experienced scientists and engineers from its naval reactor laboratories for this purpose, and in every way possible to contribute to, and to learn from, this growing technology, as envisioned in the Atomic Energy Act and the various Memoranda of Understanding between the Navy and the Commission.

I was pleased to note the assurance in your letter that the Navy plans to permit no relaxation in its policies and procedures for operation of nuclear-powered ships, for repair and maintenance of naval nuclear propulsion plants and for selection and training of personnel for the nuclear program. The Commission's experience throughout the atomic energy field indicates a growing, rather than a diminishing, public concern over reactor safety and radiation; this imposes

an increasing burden on the Commission to exercise every reasonable recourse to assure adequate public protection. You may be assured of our continued cooperation with the Navy in this joint effort which has been so successful.

Sincerely yours,

JOHN A. McCONE, *Chairman.*

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE,
PUBLIC HEALTH SERVICE,
Washington, D.C., January 4, 1960.

H. G. RICKOVER,
Vice Admiral, USN, Assistant Chief of Bureau for Nuclear Propulsion, Bureau of Ships, Department of the Navy, Washington, D.C.

DEAR ADMIRAL RICKOVER: Our staff has reviewed the final draft copy of NAVSHIPS 389-0153, "Radiological Controls for Naval Nuclear Propulsion Plants" dated November 1959, transmitted with your letter of November 12, 1959. The document appears to be technically sound and based on the best available information. It is our belief that this document will serve as an effective working guide for the assessment of radiological health hazards aboard nuclear powered naval vessels. It is an important step toward our mutual goal of meeting recommended levels of exposure through adequate and practical radiological health standards for the various operations of the Federal Government.

We appreciated the opportunity to be of assistance in this matter and look forward to future cooperation along these lines.

Sincerely yours,

FRANCIS J. WEBER, M.D.,
Chief, Division of Radiological Health.

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., June 23, 1959.

ADM. ARLEIGH A. BURKE, USN,
Chief of Naval Operations,
Department of the Navy.

DEAR ADMIRAL BURKE: This is in reference to your letters and Instructions on nuclear powered naval ships as follows:

Letter of January 21, 1958, transmitting BUPERS Instruction 1540.38 "Personnel and Training Aspects of the Nuclear Propulsion Program", dated December 31, 1957.

Letter of February 20, 1958, transmitting OPNAV Instruction 03000.5 "Operation of Nuclear Powered Ships", dated February 6, 1958.

Letter of February 25, 1958, transmitting BUSHIPS Instruction 9890.4 "Repair and Maintenance of Nuclear Propulsion Plants for Naval Ships", dated February 25, 1958.

Letter of November 25, 1958, transmitting OPNAV Instruction 03000.5A (supersedes OPNAV Instruction 03000.5A), dated November 25, 1958.

Letter of December 20, 1958, transmitting OPNAV Instruction 03040.3 "Nuclear Reactor Incident; procedures for", dated December 16, 1958.

The Commission has reviewed these procedures and Instructions and has had them reviewed by the statutory Advisory Committee on Reactor Safeguards.

In section 161 b. and i. of the Atomic Energy Act of 1954 the Commission is authorized to:

"b. establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material, source material, and byproduct material as the Commission may deem necessary or desirable to promote the common defense and security or to protect health or to minimize danger to life or property."

"i. prescribe such regulations or orders as it may deem necessary * * * (3) to govern any activity authorized pursuant to this Act, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property."

In view of the excellence and completeness of the Navy's Instructions from the standpoint of public safety, the Commission does not now deem it necessary or desirable to issue any Commission rules, regulations, or orders concerning nuclear powered naval ships. The Commission does not, by reason of this determination, accept responsibility for operational decisions made by the Chief of Naval Operations.

We note that your Instructions are designed to centralize in your office control over the movement of nuclear powered naval ships, because of the potential hazard to life and property in the event of a serious accident. We approve and commend such a system which seems to provide for flexibility of operations for ships at sea or in harbors but emphasizes safety, which is of concern to the AEC.

It is our understanding that such instructions are prepared in consultation with the Chief of our Naval Reactors Branch. We are pleased that his counsel is sought because we also rely heavily upon his advice in being assured that Navy procedures adequately provide for the safety of the public. Obviously the AEC itself cannot carry out its responsibilities for public health and safety in the field of military nuclear reactors except by arrangement with the military services.

With respect to the design of naval reactor plants, the present practice is working satisfactorily whereby the design of each new class of reactors is summarized in a Reactor Hazards Summary Report and presented by the Naval Reactors Branch and the reactor contractor for review by the Commission's safeguards staff and by the Advisory Committee on Reactor Safeguards (a statutory body). The Commission then transmits to you for guidance the verbatim comments of these reviewing bodies. The Commission also relies on the Chief, Naval Reactors Branch, to keep it informed concerning any design changes or operating data which may have reactor safety significance, in accordance with the applicable Memoranda of Understanding between the DOD and the AEC and the Navy. Thus there seems to be an adequate system in being with respect to the safety of the design, repair, and maintenance aspects of these plants. The continued adequacy of this system, however, as the Commission and the Advisory Committee on Reactor Safeguards have stated in connection with several particular safeguards reviews, requires that the care and competence with which this procedure is presently being carried out be maintained.

Similarly, the great care and attention being given to the selection and training of personnel for the Navy's nuclear program has also been specifically cited by the Safeguards Committee as essential to continued safe operation. In view of the possible serious consequence of a reactor casualty, it is of utmost importance that the operation of nuclear powered ships be entrusted only to persons whose mental abilities and qualities of judgment are commensurate with the responsibilities involved. Therefore, the Commission commends the policy and procedures in BUPERS 1540.38, which recognizes the importance of careful selection and detailed technical training of the officers and men who operate naval nuclear plants.

The Commission wishes to be of maximum assistance to the Navy in nuclear safeguards matters and to this end utilizes the Naval Reactors Branch as a means of liaison between the Navy and the Commission as agreed to in the Memoranda of Understanding. This arrangement has operated effectively; it permits the Naval Reactors Branch to draw upon all the technical knowledge available on this subject in the various parts of the Commission such as the Hazards Evaluation Branch, the Division of Biology and Medicine, and the Advisory Committee on Reactor Safeguards.

The AEC has under review the question of whether their should be any other method of adequately assuring and protecting the public health and safety with respect to military nuclear reactors. We will keep you informed of developments.

In summary, the Commission considers that the Navy's Instructions represent a practical and effective means for providing maximum assurance of safe operation of nuclear powered naval ships. As changes or additional Instructions are issued in this area, the Commission would appreciate being kept informed.

Sincerely yours,

JOHN A. MCCONE, *Chairman.*

Some Applicable Statements by the U.S. Atomic Energy Commission and the Advisory Committee on Reactor Safeguards

I. Excerpts from letters from the Advisory Committee on Reactor Safeguards and from the Atomic Energy Commission expressing confidence in, and necessity to continue, close safeguards review by the Naval Reactors Branch

1. Excerpt from minutes of Advisory Committee on Reactor Safeguards (ACRS), transmitted by a letter from the Director of Reactor Development, U.S. Atomic Energy Commission, to the Chief, Bureau of Ships, on 21 April 1955. Subject: USS *Nautilus:*

"d. These conclusions and recommendations are based in part on consideration of the high degree of training which has been given the present operators and the extent of technical review of design and operation presently being conducted. The Committee feels that maintenance of high standards in both of these regards is essential to continued safe operation."

2. In transmitting these recommendations the Director of Reactor Development, AEC, stated:

"This program has borne the responsibility of establishing policy for the routine operation of a power reactor in a populated area, as well as for special problems associated with mobile reactors, and the satisfactory solution to the hazards problems achieved in the case of the *Nautilus* has been the result of continuing effort by the Staff in the Naval Reactors Branch and the Bureau of Ships responsible for this program. Many of the problems involved have been unprecedented. It is important that future problems of this type receive the same careful and thorough attention."

3. Excerpt from letter from Chairman, ACRS, to General Manager, AEC; dated July 12, 1957. Subject: Fleet Operations, *Seawolf*:

"The Committee considers that an important factor in achieving this safety record was the high quality and degree of review afforded by the Naval Reactors Branch of the Division of Reactor Development during design and initial operation of these ships.

"In order to insure continued safe operation of nuclear powered naval vessels the Committee urges that such review be continued throughout the operation of all nuclear powered naval vessels. This review should include all aspects of design, operating procedures and operational plans which could affect reactor safety; it should also include training and qualification of personnel who operate or maintain naval nuclear propulsion plants."

4. Excerpt from letter from Chairman, ACRS, to Chairman, AEC, dated September 19, 1957. Subject: USS *Skate*, SSN578:

"This conclusion is based, as was the case for the *Nautilus* and *Seawolf*, on the Committee's understanding that the same careful surveillance as was exercised by the Naval Reactor Branch in the design of the prior nuclear propulsion plants also will be applied to those aspects of design, training, operating procedures and plans which could affect the reactor safety of the *Skate*."

5. Excerpt from letter from Chairman, ACRS to Chairman, AEC, dated August 5, 1958. Subject: S5W Power Plant:

"The Naval Reactors Branch has demonstrated its ability to monitor the design and construction of nuclear-powered vessels and to develop well-trained operating crews.

"The Advisory Committee on Reactor Safeguards, however, wishes to point out that nuclear-power ships are not completely free from presenting a possible hazard to the public. There exists an ever-present low-level risk of release of radioactivity . . .

"The Committee reiterates that the prime assurance of safety during building, operating, and repairing nuclear ships at various locations depends upon the proper prior evaluation of potential hazards. This must be done for each new situation and at present, on a case-to-case basis, by persons having a detailed knowledge of the factors influencing reactor safety. This requires that the training of officers and crews of nuclear ships must continue to emphasize knowledge of reactors and reactor safety. It also means that the experience and technical judgment of the Naval Reactors Branch must be utilized to the maximum extent in evaluating such operations. The problem assumes increasing importance as the number of nuclear-powered ships increases."

6. Except from letter from Chairman, ACRS, to Chairman, AEC, dated November 12, 1958:

"At the request of the Chairman of the Commission, Admiral Rickover described to the Committee the pertinent experience and lessons learned in the naval reactors program. The Navy's desire to bring nuclear submarines into various populous ports has resulted in considerably more of such operations than the Committee had envisioned when it first commented on nuclear submarine operation. The Committee wishes to repeat the point it has emphasized on previous occasions that entry of nuclear ships into populous ports cannot yet be considered routine or entirely without risk. In this situation, the Committee depends heavily on the technical judgment of the Naval Reactors Branch to evaluate the risk as compared with the necessity for each case. Such judgment by persons responsible for and experienced in the problems of reactor design and hazards evaluation should not be replaced by rules or by routine decisions by persons not knowledgeable in the technical factors involved."

7. Except from letter from Chairman, ACRS, to Chairman, AEC, dated March 16, 1959:

"During the review of the S1C, Admiral Rickover commented on the recent sea trials of the *Skipjack*. It was stated that the nuclear powerplant of the *Skipjack* demonstrated completely its stability and reliability during radical maneuvering, thus proving the basic emphasis placed on safety by the Naval Reactors group during the design, construction, testing, and operation of naval reactor plants is worthwhile. The ACRS continues to consider it essential that such basic emphasis on safety be continued."

8. Excerpt from letter from Chairman, ACRS, to Chairman, AEC, dated April 8, 1960. Subject: *Tullibee* SSN–597 and *Seawolf* Conversion SSN–575:

"We were very favorably impressed with the numerous means which have been set up to permit the AEC and its staff to evaluate and advise as to the reactor safety aspects of these ships.

"In reviewing these projects it is clear that Admiral Rickover and his Naval Reactors Branch have supervised the design and construction with unusual care and competence.

"The active and personal AEC participation in the construction and testing of naval reactors is essential to the maintenance of adequate standards of reactor safety.

"It is the Subcommittee's recommendation, and I concur, that the Committee review these projects at its May meeting. We believe that it is important for the Committee as a whole to understand the importance of the continued surveillance given by the Naval Reactors Branch for the success of these ships. Their achievements in reliability and safety are of importance in the overall power reactor program."

II. Excerpts from letters from the Advisory Committee on Reactor Safeguards (ACRS), and from the Atomic Energy Commission expressing concern over hazards of operating naval reactors in port

1. Minutes of the February 17, 1954, meeting of the ACRS:

"The Committee again recommended for long-range planning that serious consideration be given to providing a truly safe base for nuclear-powered ships where testing, unloading operations, etc., can be conducted without public hazards even under wartime conditions."

2. Letter of July 12, 1957, from the Chairman, ACRS, to General Manager, USAEC:

"The Committee believes that the operation of the *Seawolf* should not be unrestricted and would like to see the Navy develop principles upon which suitable ports may be selected and designate certain specific ports for operation based upon an evaluation of the hazard problem."

3. Letter of September 19, 1957, from Chairman, ACRS, to Chairman, AEC:

"The Committee is concerned that with increasing numbers of nuclear-powered ships the risks associated with operations in populous ports is intrinsically larger. It is suggested that any plans for operations of nuclear ships take this fact into consideration. Since the continued safe operation of the Navy's nuclear-powered ships has an important bearing on the development of the entire reactor program in this country, the Committee would be interested in learning of any general plans and criteria which the Navy may be developing for the operation of nuclear vessels in port."

4. Letter of March 8, 1958, from Chairman, ACRS, to Chairman, AEC:

"The ACRS has received OPNAV 03000.5, BUSHIPS 9890.4 and BUPERS 1540.38. It is sympathetic to the position taken in which nuclear safety is to be insured primarily by the action and decisions of personnel trained specifically to deal with nuclear systems and their hazards.

"The Committee endorses the present Navy practice to consult with and to be guided by the Naval Reactors Branch regarding reactor safety and operational procedures for nuclear-powered ships. It considers this practice to be important and urges its continuance.

"To maintain the present admirable safety record of nuclear powered ships, the Committee emphasizes the importance of keeping to a minimum consistent with military necessity the number of ports which nuclear powered naval ships may enter, pointing out that as the number of nuclear powered ships increase, consideration should be given to the designation of ports or bases where multiple berthing may be permitted."

5. In transmitting the above comments by memorandum dated April 8, 1958, the Director of the Division of Licensing and Regulation, AEC, stated:

"The three operational documents (OPNAV Instruction 03000.5, BUSHIPS Instruction 9890.4, and BUPERS Instruction 1540.38) seem to us to represent a good approach to the problems of operating criteria for nuclear vessels in coastal areas. We believe, however, that eventually the Navy may need to make more definitive the boundaries and limitations of the guiding principles (a) to (e) of 3.d (1) of OPNAV Instruction 03000.5 within which vessel commanders can make decisions in particular situations."

6. Memo from Director, Licensing and Regulation, AEC, to Director, Reactor Development, AEC, dated May 28, 1958, Subject: Proposed Operation of the USS *Skate* (SSN–578) and *Skate* Follow Ships (SSN–579, 583, 584 and SSG(N)587)

"In summary, it is our belief that there is reasonable assurance that the proposed operations of these submarines can be conducted without undue hazard to the health and safety of the public. However, as suggested in our previous memorandum of April 8 concerning the criteria and procedures developed by the Navy to assure safe operation of nuclear ships in populous areas, we believe that it may not be completely adequate to rely on the decisions and judgments of the commanding officers in all situations that might develop in the operations of nuclear powered vessels. Rather, it is our belief that eventually the Navy may wish to make more definitive the boundaries and limitations within which vessel commanders can make decisions concerning the operation of their ships in particular situations."

7. Memo from Director, Licensing and Regulation, AEC, to Director, Reactor Development, AEC, dated August 29, 1958. Subject: Hazards Review of S5W Core 2

"In view of the increasing number of nuclear ships now in prospect, we recommend development of operational policies and procedures under which the present degree of safety will not decrease with increasing numbers of vessels. As we suggested in our comments with regard to the *Skate* follow ships, more definite guidelines should be available to ship commanders so that their decisions concerning operation near populated areas may rest on more deliberately prepared bases; and, as suggested by the ACRS, there is need for beginning the systematic development of environmental information on coastal areas in which nuclear ship operation is contemplated."

Admiral RICKOVER. This new system was irksome to the submarine operators because up to that time they had had complete local control; they never had to discuss with anyone how to operate their ships.

For example, we found out one day by accident, before the *Nautilus* had been cleared for anything but operation out of New London, that orders had been issued for her to go through the Cape Cod Canal on the way to Boston, instead of using the open-sea route. I imagine there was some publicity reason involved. Now this canal has a narrow channel. We didn't know much about nuclear power

at that time. If anything should happen and the ship go aground in the canal there might have been serious consequences because of public reaction. And if the Navy were then asked: "Why did you have to go there?" there would have been no good answer. It is this sort of thing we are up against.

When the time came to test the *Seawolf*, our second nuclear powered submarine, we were faced with a more serious problem. The *Seawolf's* reactor was cooled by sodium, which was far more radioactive than the water coolant of the *Nautilus*. The Reactor Safeguards Committee never did fully approve operation of the ship into populous ports. They finally agreed, for military reasons, that the ship could operate out of Key West, which is a submarine base. But the operating forces objected to this limitation and, on their own, decided to move the *Seawolf* into populated ports without referring the matter to us or to the Reactor Safeguards Committee.

It took a great deal of doing and a lot of argument before they finally realized they must not move these ships around the way they were accustomed to move conventional ships. We still have that fight, even though Admiral Burke has issued instructions to the Navy that nuclear powered ships must be treated in a special way and that there must be an actual military or national necessity before a nuclear ship can go into a populated harbor. In my opinion the spirit of this order is not always being lived up to fully. That is, they write and say it is "military necessity." And the argument I put up is: "What if something happens and you irradiate a city and you are called upon to prove there really was a military necessity. What are you going to say?" "Well," they answer, "nothing is going to happen." This is the sort of situation we are up against because the nuclear plants have operated so well to date. The operators don't fully realize the reason the plants have operated so well is because a great deal of time and attention is being paid to the design, construction, and testing, and to the day-by-day operation. We are devoting considerable effort to make these ships safe and keep them safe.

Another argument goes something like this: "We now have a considerable number of nuclear reactors working reliably; this proves they are safe." Well, my organization has tried to take the lead with the Reactor Safeguards Committee and with Congress in facing the realization that no such wonderful day has yet dawned. In fact, the more reactors there are operating the more serious is the problem, because the chance of something happening multiplies with the number of reactors.

Congressman HOLIFIELD. I would like to stop you on the fact that you said now a great deal of care has been taken to design these reactors so that they are safe and you mentioned the manner of operation. Now, if you have a safely designed reactor, insofar as you know it's safe, what element of danger is there in the operation by these men in the ships? Have you got it fixed so that careless operation would change your design?

Admiral RICKOVER. In a good engineering design you try to include three safety features for each possible casualty. In this way even if a man "goofs" in one feature nothing will happen. If he "goofs" on a second feature nothing will happen. Even if he "goofs" on three

nothing will happen. But it has happened that there have been more than three maloperations simultaneously; then something may happen. Now, if you try to design for every contingency or combination of contingencies you introduce so many new gadgets into the plant that these gadgets themselves may render the plant unsafe. From my many years of experience I conclude you can design for about three "goofs" in a row and that's all. You must violate all three to get into trouble, but it can happen. This is why careful training and constant direct supervision by responsible and competent people is essential.

Congressman HOLIFIELD. So human operation is an element?

Admiral RICKOVER. Yes, sir. If you try to make the plant completely foolproof with all sorts of pushbuttons, you actually make it worse. That's a very strange and interesting phenomenon, and it is only learned from many years of practical design and operating experience.

You also have the view that since everything has been working all right, "Let's ease up on safety." The law requires the Atomic Energy Commission, I believe it is section 161 of the Atomic Energy Act of 1954, to set up rules and procedures to assure itself that reactors operate safely. The law does not say that the Atomic Energy Commission itself is responsible if anything goes wrong. But the law does charge the AEC with the responsibility of seeing to it that anyone who operates a reactor has qualified himself and knows how to operate it, and that there are adequate safety precautions. Now some people in the Atomic Energy Commission say, "Let's turn that safety problem over to other Government agencies. Why should we be responsible? Why should we control them?" These people are afraid the AEC will be held responsible for mistakes made by people in another agency. The AEC isn't responsible for an accident that happens on this ship, for example; the Navy is. But the AEC would be held responsible if they hadn't seen to it that adequate safeguard features were included in the design and the crew properly qualified to operate the plant. That's the real issue.

Another approach is to say: "Let's enact legislation leaving it to the discretion of the President which Government agency will be responsible." You know what that means: If I myself am unable to get Congress to pass a law shifting the responsibility, I use this backdoor method. That means the man who wanted to do something in the first place merely recommends it up the line. The President naturally has to accept the recommendation from the agency concerned; he can't personally go into the details of all he is charged with. So whenever someone asks passage of a law making the action a responsibility of the President, he really means: "I don't like the present law. I'll get around it and have my way by 'leaving it to the discretion of the President.'" Leaving matters to the discretion of the President would seem to me to be appropriate where rapid action for national safety is required, but I do not see any reason why Congress should give up its rights in a matter where there is no element of urgency and where the health and safety of our people is concerned.

I maintain that is completely indefensible.

Congressman HOLIFIELD. That's the law that was sent to us by the DOD and the AEC last year and we refused to pass it.

Admiral RICKOVER. That's right; I believe there are some people who will want to put it up to you again, the idea being, now that reactors have been proven "reliable," we don't have to worry any more about safety. But I don't feel that way. I have had as much experience as anyone else in this country in the operation of reactors and so I have some degree of qualification in this matter. I am more concerned than ever, because the more reactors there are, the more people are involved, and you can't keep as tight control as when there were only a few.

My idea is that the Atomic Energy Commission should stick to the letter of the law, see to it that proper instructions are promulgated, but not be responsible for the actual operation. I think the confusion arises when people think the AEC is responsible for a naval reactor, or an Army reactor, or for the case when the Air Force flies an H-bomb in a bomber. These are military operations. If a bomb is taken up in a plane and if the plane crashes and the bomb should explode it is not the responsibility of the AEC. If the AEC has seen to it that proper safety standards and instructions have been established, they will have fulfilled their obligation to the public. Because if anything happens, if any radiation accident happens, to whom are the people going to turn first? To the Joint Congressional Committee and to the Atomic Energy Commission, of course. It makes no difference how you word the law, the people will look to the AEC to provide adequate safety standards and instructions. Then they will look to the operating organization to see how these instructions were carried out. And you know there is getting to be increasing concern where radioactivity is involved.

To give you an idea of how conservatively we have designed our nuclear plants, look at Shippingport. When the Shippingport reactor is operating we can't tell from the radiation at the operation station that the reactor has been started, because we have shielded the reactor plant so well. Yet we can easily detect fallout from a Russian bomb with the same instruments. Similarly, in this ship we are able to measure the decrease in cosmic radiation when we submerge. We have instruments on board that can measure this decrease in cosmic radiation when we submerge to 100 feet or 200 feet and deeper, yet these same instruments aren't sensitive enough to show change in radiation level in the living spaces when we start the reactor. This gives you an idea of the extent we have gone to incorporate safety in our plants.

In the case of the Shippingport reactor, last year we discharged less than one-tenth of a curie of radioactive materials, plus some tritium, into the Ohio River. We have held meetings with the U.S. Public Health Service and with the Ohio River Valley Sanitary Commission and with the various State departments of health. And yet, despite all this, a university professor in Wheeling, W. Va., went to the city council and told them the Shippingport reactor is polluting the Ohio and Mississippi Rivers. Why, Shippingport is putting less than a millionth as much radioactivity into the Ohio River as the Hanford reactors are putting into the Columbia River.

The public is afraid of radioactivity. It is therefore incumbent upon all of us who have anything to do with reactors to make sure there are no accidents. Practically, how does that affect you. There are elements in the Navy who do not like the fact we use AEC help in the way

we do. The AEC helps in the design, in the testing, and in the operation of these plants. The Navy would like us to conform to the old rigid system, but if we do that we can't get the help from the AEC facilities we have always gotten. We could not then do our job properly. We could not insure the safety of these ships if we did it that way. These are the sort of problems that confront us all the time.

Congressman HOLIFIELD. If the AEC gets out of the safety picture we should ask them why they are paying all these people on their payroll who have these big job descriptions. What is the purpose of having all those experts if no one is supposed to go to the AEC in connection with matters of safety. Who will listen to advice from people who have no responsibility for anything?

Senator ANDERSON. Admiral Raborn, various agencies within the past few months have put forward the suggestion that the Polaris system should be integrated into a single strategic missile command, would you care to comment on this?

Admiral RABORN. I will try to do so. There is a widespread feeling among people less expert in submarine operations than the Navy that the matter is not very complicated. We, having had practical experience in operating submarines in conjunction with other missile vessels at sea, know that the combined operations of these ships are very complicated. This, we found from sad experience during our past years, particularly in World War II. Unless they were closely controlled under a single Navy commander it is usually true that our antisubmarine warfare forces were hesitant about closing in for a kill because they weren't quite sure that it was a friendly or actually an enemy submarine. Overzealously, as you know, we sank one of our own submarines in World War II. Now the plea is made in some quarters that in order to control warheads on targets that you should control launch sites. A submarine is a launch site. We believe this is entirely fallacious because there is a well-established organization under the control of the Joint Chiefs of Staff which has inputs from other departments of the Government. As to the division of targets, these targets are allocated between the forces that have capability of hitting them in the various parts of the world. And they have some joint operating control centers which can vary should a nuclear war break out, striking some of these targets, and it will happen. So there is an established system through the Joint Chiefs of Staff and its operating staff to define targets and to control the total forces of the United States capable of using U.S. atomic weapons. Then there are the substations which locally control the respective fields. So we see a little to be gained and lots to be lost in transferring control of all of the three services capabilities of hitting to an isolated place out in Omaha. We are quite sure that communications, once the bombs start falling, communications within the United States are going to go to pot rapidly. Fallout is going to disturb point-to-point radio, and well placed bombs on our cities are going to knock out two or three States of telephone communication. I could think of nothing worse than a theater centered around Manila or centered around United Kingdom having to turn to an isolated commander in a rock—in a hole in a rock in Omaha to do the job which he knows can be done, and that is exactly what some well-

meaning people, I am sure, would have us do. So they fall down on two cases.

(This portion of the statement classified.)

Senator ANDERSON. Would you care to comment on this? In the event of a defense emergency, how soon could we have an emergency capability with Polaris? Could you indicate the extent of the emergency capability between now and the [date classified] operational capabilities you talked about? You said this was going to be operationally capable in the fall. Do you have some sort of real rush? What could you do about it timewise?

Admiral RABORN. We could knock about 3 or 4 months off.

Senator ANDERSON. Admiral Rickover, could you bring us up to date on your training program? You told us before on how you were organized on that.

Admiral RICKOVER. All officers serving in nuclear-powered submarines except those who are concerned with the missiles of the Polaris submarines are specially selected. We interview them and recommend on their selection to the Chief of Naval Personnel. We have found that people who do not have a high mental aptitude cannot absorb the knowledge required. We give officers a year's intensive study and training. The officers are given courses in mathematics, chemistry, nuclear physics, and so forth, and then given 6 months' practical training.

We have similar courses for the sailors. We generally start the sailors by giving them half a year's college work in nuclear physics, mechanics, chemistry, and mathematics. We then give them half a year's practical training at a reactor plant prototype. These prototypes belong to the Atomic Energy Commission and they have made these facilities available to us. We use these facilities both for conducting nuclear propulsion tests and experiments and for training our crews. In this way, instead of having to support large civilian crews at these places, the sailors operate the prototypes and so become qualified to operate and repair our nuclear submarines.

The captain and the executive officer of both the Gold and Blue crews of this ship have had such a year's special training in nuclear power. Each has qualified as a chief operator of a nuclear submarine. The type of training these officers have received in nuclear power is a departure from the normal Navy way of training. Officers heretofore have not generally been required to get down and actually learn the technical details of their plants. In nuclear power they must know such details, and this is one of the main reasons the nuclear ships, starting with the *Nautilus*, are performing better than our conventional ships. The degree of reliability of these ships is higher from a propulsion standpoint than the conventional ships, due largely to the careful design and the detailed nature of the training.

Now this type of training is absolutely essential for safety of our nuclear plants. You cannot entrust a nuclear plant to people who do not have the mental capacity to absorb such training because sure as shooting you are going to have an accident.

We examine the engineering crews of each new ship before the reactor goes critical. A group of my leading people come up here to do this. I myself come up, too. We spend at least a whole day

examining the crew to find out how much they know and whether they are actually ready to operate the plant before we permit them to bring the reactor critical. We determine whether the crew is qualified to operate the propulsion plant, specifically from a reactor safety point of view. We find out whether the officers and men adequately understand the plant and its operating procedures, the plant limitations and the reasons for them, and the requirements for the control of radioactivity. We look into whether the crew understands the possible consequences of abnormal conditions, equipment failures, or operator errors. We ask both the officers and the men to demonstrate a working knowledge of the equipment. In addition, we check the ship's written orders and records to make sure that formal and adequate procedures have been set up for qualifying watchstanders on their stations, for keeping proper records of radiation exposure, and for carrying out casualty drills. We point out the areas of weakness. We give them time to correct these areas and then we reexamine them.

We have also prepared numerous technical manuals to guide the ship's force to do their job properly. This is a fine thing the AEC is doing for the Navy, letting us use their prototype facilities and helping out directly in testing, operation, and maintenance of our nuclear ships. It is truly a joint effort, although sometimes the Navy forgets it.

Congressman HOLIFIELD. Would the ordinary procedures of alternating officers into this type of vessel from other nonnuclear vessels obtain or will a nuclear officer maintain his service in a nuclear-type vessel of some kind?

Admiral RICKOVER. The demand for nuclear-trained officers is so great, not only for the nuclear ships but also for staffs, that there is presently no question of their going to a nonnuclear assignment. I thought you were going to ask me about the Gold and Blue crews. They are both equally well trained. We train two crews for each Polaris submarine. We are working with Captain Ward, the Polaris squadron commander, to set up special training facilities for the "onshore" crew so that they will always be ready to take their ship over and operate it.

Congressman WESTLAND. Are you going to keep these crews in units?

Admiral RICKOVER. The present plan is to keep the Gold and Blue crews in units; yes, sir.

Congressman PRICE. I would like to refer back to the time that Admiral Raborn mentioned a moment ago that the question of strategic command absorbing all the ballistic missile control and so forth. I think we have someone here who—a submarine officer during the war—I would like Mr. Floberg to give his comment on that same question.

TESTIMONY OF COMMISSIONER JOHN F. FLOBERG, ATOMIC ENERGY COMMISSION

Mr. FLOBERG. Senator, I don't pretend to be an old seadog or anything of that sort, but I did spend some 42 months at sea chasing these things around and I worked a good part of the war in a hunter-killer group. I would like to endorse from the other side of the street the

statement that Admiral Raborn made about the close coordination that is necessary to make the antisubmarine forces. We used to get daily communications of submarine havens, submarine routes; although we never knew the submarines by name we always knew the places where our submarines were. We were also informed of the places where enemy submarines were located. This was a constantly changing picture. It was a constant part of an overall naval operation. I can't imagine anything more hazardous to people on this ship than to divide the overall channel of authority over them. I would like to contrast the attempts made to coordinate aerial attacks on targets. There are some cases where communications went 2 weeks without being answered in efforts made to work out joint air attacks. If anything like that ever happened in case of ordinary service—I mean on these ships—I can't imagine how they could ever untangle the confusion. They would just be irretrievable it seems to me.

Senator ANDERSON. Admiral Raborn, we are embarking on a tremendous program of hardening our Atlas, Titan, and Minuteman bases within the United States. We are also informed that a portion of the Minuteman capability will be flexible—that is, operate off railroad equipment. It would be of extreme interest to the members to hear your thoughts on the comparison of these concepts with that of Polaris.

Admiral RABORN. (This portion of answer classified.)

Seriously, though, I think the concept of [classified] when it was started about 12 or 14 years ago, actually was very commendable. The efforts of the United States to get this weapon into its arsenal is also commendable.

(This portion of answer classified.)

I think the most unappreciated element in our national defense today is the element of time. So many people are thinking of days, literally weeks of making national decisions and then doing something about it. Now it takes 30 minutes to get an ICBM warhead from one continent to another. This puts an entirely new element into the national defense decision-making scheme of things and this time is all out of proportion to what it used to be. I wonder if people realize the practical difficulties of detecting something coming toward you, identifying it, of communicating that information to one or maybe two subcenters before you get to the President and then the inevitable question, "Are you sure?" because no one man in this world, or in our country, wants to go down in history as the man who, through inadvertence, started a nuclear war. So this is what you are asking—what you are asking a man to do, when you are telling him in all seriousness and all sincerity that we are under nuclear attack. And mind you, you have something in the order of maybe not greater than 30 minutes to decide on this. So when we have these kind of things which we call retaliatory forces.

(A classified portion follows.)

Now turning to Minuteman, I think Minuteman will be an excellent weapon. But they are as far away from operational readiness as when we started on Polaris. They say they are going to have Minuteman ready in 1963, perhaps start in production in 1964. Three years ago we started Polaris. Today we are coming into operation. So you see there is a time here when you are going to have to work

out some problems. They will come along much faster. Especially with the Polaris pioneered we are just delighted to be able to offer something like that because we in turn, as you know, have received a great deal of help from technology from the Army and Air Force. We have literally capitalized on this. I can give you example after example where this has happened. We in turn make all our plans available to the Air Force.

If you have these ICBM's fixed, then from a practical point of view they are vulnerable because their addresses are certainly going to be known to the Soviets.

(A classified portion follows.)

I am a strong convert to get these weapons to sea.

(Remainder of statement classified.)

Congressman VAN ZANDT. Give us the estimated cost of installing 16 on the heavy cruiser?

Admiral RABORN. With missiles about [classified amount] dollars per tube for two and that takes in all equipment, personnel up to about 8 tubes and then from then on the cost of the others drops off rapidly because you have a certain amount of common equipment that would take care of about 16 tubes.

(A classified portion follows.)

But believe me, when you equate assuredness of having them when you want them, putting a proper price tag on that, it's a pretty cheap weapon. I am somewhat unimpressed by the sharp pencil pushers that show me that this is 10 cents cheaper when in reality it won't go when you want it. It is just like going down and buying a car. Sometimes it pays to pay $30 more for a car, if you are going to pay for it, and get one that's a real Jim Dandy rather than one that is a lemon. This kind of economy is false. A cruiser is a mobile thing; it is not a good target for a ballistic missile. Even if it is at anchor, or tied up at a dock overseas, you have got to think that you can still get these things off in 15 minutes time, making them an awful good launching site.

Congressman PRICE. I hope it works out better than the car example because you don't know a lemon in a car until after you have paid for it.

Admiral RABORN. That's true.

Congressman BATES. We were given a figure that a cruiser converted for this purpose would cost about a third of the Polaris submarine.

Admiral RABORN. That's about right.

Congressman HOLIFIELD. There are two important things you must remember: One is that we have our own bases; you don't have to depend on some of these foreign bases which in themselves run into half a billion dollars. I am thinking of a cruiser, for instance, and our Spanish bases. They are under the control of foreign governments or nearly under their control, I guess. In fact I guess they all are under political control or subject to changes of political domination. The second thing is the very important thing—our studies show that the downwind contamination of square miles from each one of these missile explosions can run from 7,000 to 20,000 square miles downwind from where the bomb explodes. If we are going to have these bases, fixed bases that are known to the enemy, in our own Z.I. we

have got to think about that. Now this, I think, is a good place to tell you what General LeMay said the day before he testified before our committee. We asked him about the vulnerability of the fixed bases. He said a 1-megaton weapon might knock out a—would probably knock out a soft base but he said if we hardened the base to a hundred p.s.i. it would take, he estimated, 30 to 50 times as much. I asked him about the missile installations in the Denver area which is a magnet target for 30 or 50 megatons. Even if your base survives a terrific shock what happens to the civilian population in the fallout pattern downwind. He said that's the job of the Federal Civil Defense Administration. "My job is to have the missiles ready and get them off."

Admiral RABORN. I would just like to comment. I don't know of any study that has been made which would support such a contention. All bases, even a hard one, can be knocked out and this includes a hundred p.s.i. base. You don't have to bend the gun barrel very much to make it unusable.

Congressman HOLIFIELD. I was going to take you up and ask you to elaborate on that point if you have studied it.

Admiral RABORN. We have any number of studies which you can get on request from the Defense Department which would give you more accurate information. I think this would be the proper way to clear this up.

Congressman HOLIFIELD. You showed us some hard bases a few moments ago. What is the cost of those hard bases in comparison? [Remainder of question classified.]

Admiral RABORN. I have the cost figures. I didn't want to show them because I didn't have the time. Some of my remarks are top secret. [Remainder classified.]

Congressman HOLIFIELD (classified).

Congressman VAN ZANDT. I have been informed that Vandenburg Air Force Base, the whole complex will run about $3 million. That's not a hard base. Does that sound about right?

Admiral RABORN. Yes, sir. Actually, sir, for what you get you are going to have to pay for it. Just like a good suit of clothes—a good suit of clothes has a pretty nominal price, a common price throughout the United States.

Congressman VAN ZANDT. Isn't it true—we are talking about these hard bases—they are running around $25 or $30 million apiece and when the missile has been launched there is no further use for the hard ——.

Congressman PRICE. Are you talking about the tube?

Congressman VAN ZANDT. I am talking about the tube.

Congressman PRICE. I don't know the testimony on the reuse. They can be reused except that they can't be immediately reused. They have to be reworked.

Congressman VAN ZANDT. The ones we are building now can only be used for the Atlas-type missile.

Congressman PRICE. That's the one that is being built for the Atlas. I'm not saying that as an argument.

Mr. RAMEY. What is the effect of the cutbacks on attack submarines?

Admiral RICKOVER. As I understand it the Navy has recommended that in order to accelerate the Polaris program two of the three

attack submarines in fiscal 1961 program be deferred In my opinion this is an unfortunate recommendation. I agree with Congressman Van Zandt that we should, on the contrary, considerably enhance the attack submarine program because they are the "bread and butter" submarines of the Navy. The Russians, as the Navy has told you for many years, have a fleet somewhere between 400 and 500 submarines, of which 300 are modern—that is, they have been built since the end of the war—whereas we have built only 26 new submarines since the end of the war. By 1965 we will have only 14 conventional submarines that are not overage. So if we don't start building more attack submarines at once we are going to find ourselves in a position where we have no way of really keeping the Russian submarines in hand, and many of the Russian submarines can carry missiles. The best way we know today to defeat an enemy submarine is by means of our own nuclear-powered submarines. We have the capacity to build 10 more a year.

Congressman VAN ZANDT. We have nine nuclear-powered submarines in operation.

Admiral RICKOVER. Ten, with the *Patrick Henry*, sir.

Congressman VAN ZANDT. We have eight more coming the rest of this year and we have nine coming up next year.

Admiral RICKOVER. There will be many more in the near future.

Congressman VAN ZANDT. From the cost standpoint is there any standardization taking place that would have a tendency to reduce the cost per boat?

Admiral RICKOVER. Yes, sir. But the cost of the nuclear propulsion plant is not high now, sir. It is only about $12 or $13 million, whether for a Polaris submarine or an attack submarine. And that cost includes the nuclear fuel. Actually for this $12 or $13 million we are now getting considerably more than we used to get because the life of the nuclear cores has been considerably increased. For example, we just finished installing the third core in the *Nautilus*. That core will be capable of steaming for about 120,000 miles, compared with 60,000 on the first one, yet the cost of this new one is 20 percent less. The core in the *Skipjack* cost us $4½ million, but we are buying cores now with longer life that cost half as much.

Congressman VAN ZANDT. That touches on the point I was working to. You are improving the various phases of the nuclear-powered submarine.

Admiral RICKOVER. Yes, sir.

Congressman VAN ZANDT. And instead of sending this ship alongside a dock and cutting a hole in the hull and lifting out the entire core you can replace this core—the core on this ship, can you not?

Admiral RICKOVER. We have to cut a hole in the hull of this ship. We are trying to get to the point where we will be able to refuel individual fuel elements from a tender so the ship doesn't have to return to the United States.

I have stated in previous testimony that the cores we are now manufacturing will enable these ships to operate for about 4 years without refueling It has been said, "What's the point in operating a ship for 4 years without refueling because a war won't last that long?" The fact we have a core that frees us of bases means we can go out far from the United States and operate at anytime, anywhere, even

though our bases were to be destroyed in a nuclear attack. Furthermore, it has been our custom to overhaul submarines about every 18 months. We are now extending that period to 3 years or so to coincide with nuclear core renewal. That increase in overhaul time in itself is not only a considerable saving, but also enhances reliability of the machinery because machinery is more reliable when it is kept operating. These are collateral savings and advantages.

Congressman VAN ZANDT. We know that you are working on the natural circulation reactor program. That's intended, of course, to cut down space occupied by the reactor.

Admiral RICKOVER. It will eventually. In the beginning it will provide two major advantages. First, it will give us a quieter submarine, and quietness is extremely important for submarine operations. Second, it will be a much simpler plant. Also, in connection with the natural circulation reactor plant, we are getting money from the Navy Department to develop a new steam propulsion plant, which we hope will be considerably simplified. In this way we will achieve improvements and simplification in the reactor plant with the money your committee has authorized, and do the same also for the steam part of the plant.

Congressman VAN ZANDT. I studied here today the control features of this ship. What are you doing to solidify or shrink?

Admiral RICKOVER. The reactor of this ship has [classified] control rods. On the ships that follow this one we have reduced the number to [number classified]. We are also designing reactors in which that number is reduced still further. The ideal type of reactor would be a static device with no moving parts at all, because when control rods are used the neutron flux is distorted and the reactor is less efficient as a heat transfer device. If possible we would like to eliminate all control rods [classified]. We feel certain we can at least reduce the number of control rods. That will also reduce the cost.

For example, in the Shippingport reactor the second core will have 20 control rods instead of 32 as in the first one.

Senator ANDERSON. Admiral Raborn, we had asked you for some cost figures.

Admiral RABORN. May I have the viewgraph? There are the different types of Polaris installations and their funding and total costs. These are estimates, but they are based on some rather good looks by ourselves and our contractors. Also the dates, that you could have them.

Congressman HOLIFIELD. Would you please explain the difference between a fixed hard and a fixed soft base and also how many tubes are figured in each one of those bases?

Admiral RABORN. In a fixed soft there are [number classified] each. That means then that you have one fire control system serving [number classified] that are erected on presurveyed sites and against selected targets—preselected targets, simplifying the fire-control problem a bit. Those are out where you could put them behind mountains or give them such natural coverage as would be available. The fixed hard are those that are in hardened bases up to 100 p.s.i.

(Remainder of statement classified.)

Congressman PRICE. Would you clarify this chart [chart classified]. Is this a recommended program?

Admiral RABORN. This is what we gave the Department of Defense at their request. As you know this discussion is going on now.

Congressman PRICE. But you have figures in there for fiscal 1961?

Admiral RABORN. Yes, sir. They asked us if under this set of conditions, if we gave you money by April 1, what could you do and how much would it cost this year, next year, and so on until completion? [Remainder of statement classified.]

Congressman PRICE. Could you tell us exactly what you would be able to do in this year's budget for the Polaris program?

Admiral RABORN. Yes, sir. For the Polaris program we will build three additional submarines and we have long range for three submarines presently. Taking the funds contained in the 1961 budget for two nuclear submarines, using that fund to buy long leadtime items for six more, making a total of nine in the fiscal 1962 budget. And also recently we were given permission to us $52 million to accelerate as I showed you.

Congressman PRICE. What do you mean? You are not going to get two nuclear-powered submarines——

Admiral RICKOVER. Attack submarines.

Congressman PRICE. Instead of these two you are going to get lead-time items for the six Polaris-type submarines?

Admiral RABORN. Yes, sir.

Congressman PRICE. This means reactors and so forth?

Admiral RABORN. Yes.

Congressman PRICE. How does that program work out? Is that a satisfactory—does that expedite the program?

Admiral RABORN. It is considerably better than the three and three which was in the original budget.

Congressman HOLIFIELD. Would you clarify what you mean by lead-time items? You are talking about reactors but not hulls?

Admiral RABORN. That's right. There are about four or five items that fall in long lead-time items. Well, there is about a dozen, but the three longest would be motor-generator sets, the reactors, of course, and its own machinery.

Congressman HOLIFIELD. Can you pick up that lag and not having your hull being built? Can you pick it up without overall delay?

Admiral RABORN. No, sir. Our estimate—and I checked this with two or three other people, including today with some of you—we could pick up about, if at the start of a fiscal year, we have a fully funded submarine, we could pick up about 6 months over just buying long lead-time articles 1 year then fully funding it in the next fiscal year. This, because you would start out—buy your steel and let contracts for all your other long lead-time equipment and have them flow in in an integrated way.

Congressman PRICE. Did the Navy recommend this way of doing it?

Admiral RABORN. No, sir. The Navy recommended that we go ahead with a 9 and 12 program. This would be 9 in 1961 and 12 in 1962.

Congressman HOLIFIELD. Could I ask you what this failure to concur with the whole program means in terms of overall loss of time?

Admiral RABORN. Well, it means about 6 months in ready-for-sea dates.

Congressman HOLIFIELD. About 6 months?

Admiral RABORN. Yes, sir.

Senator ANDERSON. Don't be shocked if Congress goes ahead and gives you both the attack submarines and the Polaris.

Admiral RICKOVER. I certainly hope Congress does. I think this is entirely a budget problem. The Navy, of course, wants to get an aircraft carrier, lots of Polaris submarines, also the attack submarines; but the Navy is faced with the problem of which ships to sacrifice first if they must from budgetary considerations. I believe they would kill the attack submarines off first, then the Polaris submarines, and finally the aircraft carrier. The Navy is now spending about 50 cents out of every dollar on naval aviation. About 10 cents out of every dollar is going to submarines.

Senator ANDERSON. We have been here an hour and a half or more. I don't want to impose on you as I have taken more time than I should have but I want you to answer one question. I want to say to you both that this is one of the most valuable sessions the Joint Committee has had. We had to get a long way beneath the surface to get it done but we certainly have had it. Is there any objection by any part of the committee if we say to both of these admirals that they can go over this transcript here before we see it and put it into our permanent files. I think they have been very frank with us here tonight. Admiral Raborn stopped after he said something once and said this was top secret. I realize why because he gave us a very honest answer to a very tough question. I don't want to get him in trouble for making an honest answer. It is highly classified but it might be even desirable for us to have in the subcommittee.

Congressman HOLIFIELD. There is one question and I don't want the answer to it right now, but we were somewhat concerned out in California with the so-called desalinization reactor in Point Loma. We understand that you did recommend against that location. I am not saying that you weren't right in doing so but I would like to have, if you would, put into the record the reasons for that. Was it from a safety standpoint because you are going to have submarines in San Diego Harbor, that you didn't want to add another element of contamination? Or will the submarines contaminate the San Diego Harbor in any degree? And how do you dispose of the waste products of the submarine? I am not asking you to answer now but I would like for you to put a statement into the record on this particular point.

Admiral RICKOVER. May I answer that question briefly, sir. I learned by accident that a reactor to distill fresh water from sea water was to be built at Point Loma, in San Diego. Now the Polaris people had looked over all available sites on the Pacific coast and came to the conclusion that the Point Loma site was the best one for a Polaris submarine base. As you know, the Safeguards Committee subsequently turned the Point Loma site down and made their reasons public. I had previously recommended to the Secretary of the Navy that we not permit a large reactor to be placed on Navy land so close to the prospective Polaris submarine base, because it would mix up the radiological effects of the Polaris nuclear submarines and we could never tell, if anything went wrong, what caused it. We felt it was not wise to mix the two, particularly since a board appointed by the Department of the Interior initially preferred other sites to the one at Point Loma. I believe seven sites in California were con-

sidered. Why Point Loma was finally chosen instead of the other preferred ones I don't know.

Senator ANDERSON. Check that because I thought the Department of Interior said four.

Mr. ROCKWELL. Seven was our understanding, sir.

Congressman HOSMER. I think we had four. They brought this seven figure down to four.

Admiral RICKOVER. But the Reactor Safeguards Committee for their own reasons, which have now been made public, recommended against the Point Loma site.

Mr. ROCKWELL. The point is that our continued operation of nuclear submarines in any populous area is based on a continuing record of no detectable radioactivity above the natural background level. We have an agreement with the U.S. Public Health Service that if ever in the vicinity where nuclear submarines are operating an increase in the radioactivity in the background is detected, this would then be considered cause to reevaluate the whole question. We didn't want to be caught in that position and then find that we had to prove it was not we, but the other fellow, who was contaminating the water.

Senator ANDERSON. I am not going to worry about it because you are going to give us a statement on it. I do think that they contend equally well that they are not going to contaminate it so, therefore, why should you? Why do you convict him without a hearing? That's their theory on it. We fought in the Congress and had a terrible time over a little strip of ground out in California that the Marines had to have, which they are now declaring surplus.

Congressman PRICE. As I understand your position, you are not saying either one would make it contaminated, but you are saying that if both of you are in there and there is contamination, then it would have to be decided which one did it.

Admiral RICKOVER. Yes, sir. Perhaps the best thing is for me to put the letter I sent the Secretary of the Navy into the record. I expressed my reasons in that letter and I will try to get that letter inserted into the record.

Senator ANDERSON. Please insert that letter in the record.

(The letter referred to follows:)

N1-1 (1500)
Ser 1500-1201
5 Jan 1960

From: Assistant Chief of the Bureau of Ships for Nuclear Propulsion.
To: Secretary of the Navy.
Via: Chief, Bureau of Ships.
Via: Chief of Naval Operations.
Subj: Proposed location of a Saline Water Conversion Nuclear Reactor Plant at Point Loma, California
Ref: (a) First Endorsement 44PW Ser 0781/44PW of 5 Nov 1959 on CO&DIR NEL SDIEGO conf ltr 11011 Ser 5100-011 of 23 Oct 1959

1. A Joint Memorandum of Understanding between the U.S. Department of the Interior and the U.S. Atomic Energy Commission provides that a saline water conversion plant be built on the West Coast. This plant would utilize heat from an experimental nuclear reactor. A site selection board established by the Department of the Interior has recommended that this reactor plant be located on Point Loma, California—a site suggested by the City of San Diego. This is one of seven locations recommended by the State of California. The Point Loma site is Navy property, under the management control of the Bureau of Ships and under the local command of the Director, U.S. Navy Electronics Laboratory.

2. The Chief of Naval Operations has informed the U.S. Atomic Energy Commission of his intention to base nuclear powered submarines at Point Loma. This location, approximately 3 miles from the proposed reactor site, has been reviewed from a reactor safeguards standpoint with the Advisory Committee on Reactor Safeguards and is the only West Coast port that is currently available as a home port for nuclear powered ships.

3. Operating an experimental nuclear reactor in this vicinity would raise serious questions for the Navy regarding the radioactivity discharged from that reactor during normal operation as well as the possible consequences of a reactor casualty.

4. The proposed reactor would necessarily have several characteristics that would make these radioactivity problems more acute. First, the reactor is to be *experimental* in design and operation. Thus the degree of assurance against malfunction is uncertain. Second, the reactor is relatively *high-powered*: 30,000 to 40,000 kilowatts of heat, as compared with most research reactors elsewhere which operate at 100 kilowatts or less. This is pertinent because the accumulation of toxic fission products in the reactor increases proportionately with the reactor power, and the potential hazard depends directly upon this quantity of accumulated fission products. Third, the reactor would presumably operate at high power for *long periods of time*, as opposed to the intermittent operation of a research reactor. This further increases the hazard. Fourth, the reactor plant is intended to process *20 million gallons of sea water per day*. A leak or casualty, even a minor one, could contaminate this large quantity of sea water, and thereby present a radiological contamination problem to the entire surroundings.

5. An example of the problems imposed by a high-powered reactor handling large quantities of water is afforded by the Hanford Reactors in the State of Washington. Because of the possibility of radioactive contamination from a reactor casualty, several hundred square miles of land downwind and downstream from these reactors has been withheld from other use.

Even during normal operation, the effluent from the Hanford Reactors causes an increase in the radioactivity of the river water which is easily detectable many miles from the reactors. This radioactivity is not considered by the Atomic Energy Commission to constitute a public hazard in the thinly-populated area surrounding the Hanford Reactors; but even so, the radioactivity continuously discharged adds up during the year to several million times the radioactivity normally discharged by a nuclear submarine. If large quantities of radioactive water were to be discharged into the ocean off Point Loma, the Navy would probably not be able to demonstrate that the radioactivity had no connection with the operation of nuclear submarines in that vicinity.

6. Public acceptance of the operation of naval nuclear powered ships in populated areas is based in part on the fact that such operations have as yet caused no detectable increase in the natural background radioactivity of the harbor waters, as shown by regular monitoring by local and State Public Health officials and by the Navy. I have previously indicated to the U.S. Public Health Service, the Atomic Energy Commission, and the Congress that we would re-evaluate our operating criteria and procedures for nuclear powered naval ships if any evidence were ever to develop that operations of nuclear powered ships cause a significant increase in the radioactivity of the environment. Thus, if the water or air in the vicinity of Point Loma were to show an increase in radioactivity—regardless of the reason—the entire concept of operating naval nuclear powered ships in populous ports could be placed in jeopardy.

7. In view of these facts, I recommend that, if you intend for the Navy to carry out its plans to operate nuclear powered ships at Point Loma, you do not release the Navy land for the construction of the saline water conversion nuclear reactor plant. I understand that planning by several agencies is proceeding rapidly on the assumption that the Navy will relinquish its rights to the Point Loma land. I also understand that the press is being given that impression. I suggest that you take steps at once to inform the Commandant, Eleventh Naval District, and others as appropriate that the Navy has not yet determined that the land will be made available.

8. A number of other sites were considered for the reactor plant in California, some of which I understand are as desirable from a technical standpoint as the Point Loma site. The major argument given by the Commandant, Eleventh Naval District, in reference (a) in favor of Point Loma is the desire to maintain good public relations between the Navy and the City of San Diego. I suggest that if it were made clear to the City by the Navy that building a reactor at Point

Loma would jeopardize the buildup of a new submarine operating base there, with its considerable facilities and personnel, the City might view the matter differently.

H. G. RICKOVER,
Assistant Chief of Bureau for Nuclear Propulsion.

Copy to CNO: OP–07 OP–75.

Congressman HOLIFIELD. Is there any discharge of water from a submarine, that is contaminated at anytime during its operation?

Admiral RICKOVER. Yes, sir. As I testified to your committee last year, our rules require that the water we discharge must not cause a measurable increase in the radioactivity of the harbor. Actually, our experience so far shows the water we discharge has less radioactivity in it than the permissible drinking-water levels. You could drink that water safely, right from the reactor plant. Also, the amount of water we discharge is very small, it is all carefully monitored, records are kept, and the records are made available to the State health authorities, to the U.S. Public Health Service, the Congress or anybody else. There is absolutely no danger from the water we discharge.

Senator ANDERSON. Are there additional questions?

(No response.)

Senator ANDERSON. Thank you very much.

(The committee meeting adjourned at 9:55 p.m., April 9, 1960.)

APPENDIXES

APPENDIX 1

OPERATION SCHEDULE U.S.S. "GEORGE WASHINGTON" (SSB(N)598), 9 AND 10 APRIL 1960

9 April 1960:

1330 Station the maneuvering watch, line handlers topside *when directed.* Rig ship for dive. Do not pass words to bridge or test alarms until directed.
1430 Underway from Berth "C" East, proceed to operation area HOTEL East.
1515 Operate with PATRICK HENRY.
1545 Man Battle Stations—Missile.
1600 Official party assemble topside for surface sabot shoot.
1605 Sabot count-down.
1615 Official party go below—secure topside for dive.
1625 Dive for trim and submerged sabot launch.
1650 Set condition 2 SQ.
1700 Set condition 1 SQ.
1701 Start sabot ripple fire.
1710 Secure sabot launch. Secure from Battle Stations—Missile.
1715 Informal tours of ship for guests.
1725 Surface—proceed to lane ZULU for submerged operations.
1745 Catholic Mass in Torpedo Room.
1800 Evening meal in wardroom—first sitting.
1835 Pass Montauk Point.
1845 Evening meal in Crew's Dinette.
1945 At 35 fathoms curve—dive.
2245 At 100 fathoms curve. Conduct submerged operations.

10 April 1960:

0100 Secure submerged operations return to port.
0700 Catholic Mass in Torpedo Room. Protestant Church Services as announced.
0800 At Point ALPHA.
0830 Tugs alongside.
0930 Moor Electric Boat Division—Official guests depart.

APPENDIX 2

DEPARTMENT OF DEFENSE,
OFFICE OF PUBLIC AFFAIRS,
Washington 25, D.C., July 20, 1960.
NO. 820-60
OXford 7-6161

News release, please note date.
For the press:

A POLARIS test vehicle was launched from a submerged submarine today in the first full scale test of all elements of the Navy's fleet ballistic missile weapon system. The submarine making the historic launch was USS GEORGE WASHINGTON, first of the nation's nuclear powered missile launching submarines and one of two scheduled to be deployed this year on operational patrol. The submarine was cruising submerged about 30 miles off Cape Canaveral, Florida, in the Atlantic at the time of the test, 1:39 P.M. (EDT).

The launching and test flight were evaluated as successful in meeting all the test objectives of a live missile launch from beneath the surface of the ocean and guided flight to a pre-selected impact area. Range of the flight was more than 1000 nautical (1100 statute) miles.

DEPARTMENT OF DEFENSE,
OFFICE OF PUBLIC AFFAIRS,
Washington 25, D.C., July 20, 1960.
NO. 822–60
OXford 7–6161

News release, please note date.

For the press:

A second POLARIS test vehicle was successfully launched from the USS GEORGE WASHINGTON at 4:32 P.M. (EDT) today.

Earlier today the first launching of a POLARIS test vehicle from a submerged submarine was made at 1:39 P.M. (EDT).

In both launches, the GEORGE WASHINGTON was cruising submerged about 30 miles off Cape Canaveral, at the time of the tests; the launching and test flight were evaluated as successful in meeting all test objectives of a live missile launch from beneath the surface of the ocean and guided flight to a pre-selected impact area. The range of the flight was more than 1000 nautical (1100 statute) miles.

APPENDIX 3

Naval Message—Unclassified—Navy Department.
Released by: Adm. Burke.
Date: 21 JUL 60.
From: CNO.
To: COM 6.
Info: USS GEORGE WASHINGTON//CINCLANTFLT//COMSUBLANT//COMSUBRON 14//SPO WASH DC.

For delivery to RADM Raborn via Capt Scanland, NAD Charleston

The free peoples of the world must be cheered tremendously today by the Navy's success in its first firing of a Polaris missile from under the sea. Once again, the Navy has dramatically illustrated the direct relationship that exists between the oceans of the world and the preservation of freedom. It is not an accident that most free nations of the world have at least part of their border on the sea, for it is from the oceans that the Navy can support a nation's desire to remain free, using the precise amount of power required—quietly and effectively—to ensure this freedom.

As Polaris-carrying submarines take their unknown stations throughout the world, the knowledge by free peoples of the world—and those desiring freedom—that a Polaris submarine MIGHT be in the depths of international oceans, will give them additional determination to guard their freedom with every facility at their command. This knowledge may even instill new confidence in those nations who have been threatened by aggression from communism, or who face such threats in the future. Such nations, even if they do not have a border on the sea, can now face aggressive threats with renewed resistance, knowing that a Polaris submarine may be cruising within range of the aggressor nation.

The men who man these submarines must have great technical competence, for in their ship may lie the instrument which will determine whether our civilization, with its unshakeable trust in God and belief in the dignity of man, will remain free or whether it will fall to the ravages of communism, with its debasement of human character.

You and the many people who had influence on this achievement can take great pride in the contributions you have made to this civilization and the preservation of the free way of life. Arleigh Burke.

APPENDIX 4

UNIVERSITY OF CALIFORNIA,
LAWRENCE RADIATION LABORATORY,
Berkeley, Calif., August 18, 1960.

Hon. JOHN A. MCCONE,
Chairman, U.S. Atomic Energy Commission,
Washington, D.C.

DEAR MR. MCCONE: I have just returned from a trip on the U.S.S. *Patrick Henry*, one of the Navy's nuclear-powered submarines designed to fire Polaris missiles. Accompanying me on this trip were the Advisory Committee on Reactor Safeguards, Commissioner Wilson, Admiral Rickover, General Starbird, and members of the Commission staff. I appreciated the opportunity to see at first hand the operation of one of our latest naval nuclear-powered plants, review its salient safety features, and observe the performance of the crew. I was truly impressed with all that I saw.

I know that you are acquainted with my great concern about the dangers associated with the operation of mobile reactors. I feel that such reactors are inherently more dangerous to the public since they can be involved in collisions and crashes, in addition to the other casualties that must be considered in evaluating the safety of a reactor plant.

My trip on the *Patrick Henry* convinced me that the care that has been exercised in the design, building, and testing of naval nuclear powerplants together with the intelligence and extremely high state of training of the Navy crew has greatly minimized the risk, but has not eliminated it.

The safety record of these nuclear-powered ships is impressive. I know that this is due in a large measure to the safety criteria established by Admiral Rickover in his close working with the Reactor Safeguards Committee. I also know of the pressure he has been under to relax these standards in design and training In light of the risks that are unavoidably involved, it is of concern to me, and I am sure to the members of the Reactor Safeguards Committee, that such pressures do exist.

Admiral Rickover and his staff have an excellent insight into the entire reactor safety field. Undoubtedly their naval plants are setting the pace in the field of reactor safety. With so many nuclear submarines contemplated, the Navy is fortunate to have such a qualified group to advise them; their advice should be respected.

The application of nuclear power to our naval vessels is extremely important; it has given naval warfare a new dimension. In view of the importance of these ships to our national defense, we must accept the inescapable risk associated with their operation.

My conclusion, however, that such risks are acceptable, is based on present design standards, maintaining the present care in building these powerplants and testing them, and maintaining careful selection and training of their operating crews. My conclusion would change if the standards were relaxed.

We must not be deluded by the excellent safety record made to date; such a record is not intrinsic to any reactor plant. Reactors are not, ipso facto, safe devices.

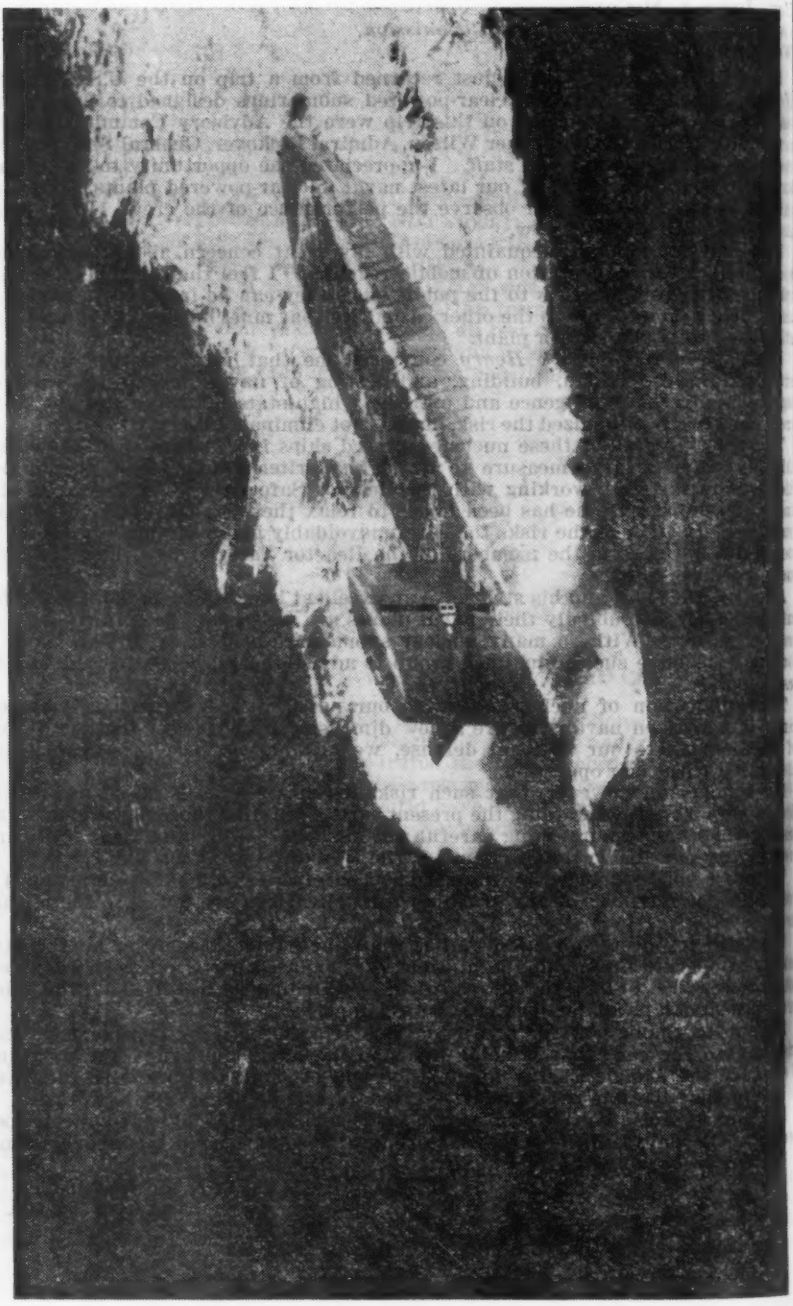
It is still my deep conviction that it would be wrong, in spite of all the care taken, to operate these ships in and out of populated ports unless it was absolutely necessary. Since the entire world is watching us in this field, the same prudence should be applied in visits to foreign ports.

I want to thank you for arranging this trip for me, for it gave me great insight into the care that is being taken in the naval nuclear power program. I am sure the Atomic Energy Commission will continue to work with the Navy to insure that the fine record achieved to date will be upheld in the future.

I would appreciate it if you would send copies of this letter to the proper people in the Navy; I believe they may be interested in some of these conclusions.

Sincerely yours,

(S) Edward Teller,
EDWARD TELLER.

APPENDIX 5

(Photographs showing the U.S.S. *George Washington* at sea, and underwater launching of Polaris missile.)